

Estimates of Commercial Harvest and Escapement of Coho Salmon Stocked Into Northern Cook Inlet Streams, 1995

by

Paul A. Cyr,

Barry L. Stratton,

and

James J. Hasbrouck

February 1997

Alaska Department of Fish and Game

Division of Sport Fish



Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)		General		Mathematics, statistics, fisheries	
centimeter	cm	All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.	alternate hypothesis	H _A
deciliter	dL	All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	e
gram	g	and	&	catch per unit effort	CPUE
hectare	ha	at	@	coefficient of variation	CV
kilogram	kg	Compass directions:		common test statistics	F, t, χ^2 , etc.
kilometer	km			confidence interval	C.I.
liter	L			correlation coefficient	R (multiple)
meter	m	east	E	correlation coefficient	r (simple)
metric ton	mt	north	N	covariance	cov
milliliter	ml	south	S	degree (angular or temperature)	°
millimeter	mm	west	W	degrees of freedom	df
		Copyright	©	divided by	÷ or / (in equations)
		Corporate suffixes:		equals	=
		Company	Co.	expected value	E
		Corporation	Corp.	fork length	FL
		Incorporated	Inc.	greater than	>
		Limited	Ltd.	greater than or equal to	≥
		et alii (and other people)	et al.	harvest per unit effort	HPUE
		et cetera (and so forth)	etc.	less than	<
		exempli gratia (for example)	e.g.,	less than or equal to	≤
		id est (that is)	i.e.,	logarithm (natural)	ln
		latitude or longitude	lat. or long.	logarithm (base 10)	log
		monetary symbols (U.S.)	\$, ¢	logarithm (specify base)	log ₂ , etc.
		months (tables and figures): first three letters	Jan,...,Dec	mid-eye-to-fork	MEF
		number (before a number)	# (e.g., #10)	minute (angular)	'
		pounds (after a number)	# (e.g., 10#)	multiplied by	x
		registered trademark	®	not significant	NS
		trademark	™	null hypothesis	H ₀
		United States (adjective)	U.S.	percent	%
		United States of America (noun)	USA	probability	P
		U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)	probability of a type I error (rejection of the null hypothesis when true)	α
				probability of a type II error (acceptance of the null hypothesis when false)	β
				second (angular)	"
				standard deviation	SD
				standard error	SE
				standard length	SL
				total length	TL
				variance	Var
Weights and measures (English)					
cubic feet per second	ft ³ /s				
foot	ft				
gallon	gal				
inch	in				
mile	mi				
ounce	oz				
pound	lb				
quart	qt				
yard	yd				
Spell out acre and ton.					
Time and temperature					
day	d				
degrees Celsius	°C				
degrees Fahrenheit	°F				
hour (spell out for 24-hour clock)	h				
minute	min				
second	s				
Spell out year, month, and week.					
Physics and chemistry					
all atomic symbols					
alternating current	AC				
ampere	A				
calorie	cal				
direct current	DC				
hertz	Hz				
horsepower	hp				
hydrogen ion activity	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

FISHERY DATA SERIES NO. 97-3

**ESTIMATES OF COMMERCIAL HARVEST AND ESCAPEMENT OF
COHO SALMON STOCKED INTO NORTHERN COOK INLET
STREAMS, 1995**

by

Paul A. Cyr,
Barry L. Stratton,

Division of Sport Fish, Anchorage

and

James J. Hasbrouck

Division of Sport Fish, Research and Technical Services, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

February 1997

This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-11, Job No. E-2-5.

The Fishery Data Series was established in 1987 for the publication of technically-oriented results for a single project or group of closely related projects. Fishery Data Series reports are intended for fishery and other technical professionals. Distribution is to state and local publication distribution centers, libraries and individuals and, on request, to other libraries, agencies, and individuals. This publication has undergone editorial and peer review.

*Paul A. Cyr, Barry L. Stratton,
Alaska Department of Fish and Game, Division of Sport Fish,
and James J. Hasbrouck
Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, AK 99518-1599, USA*

This document may be cited as:

Cyr, Paul A., B. L. Stratton, and J. J. Hasbrouck. 1997. Estimates of commercial harvest and escapement of coho salmon stocked into Northern Cook Inlet streams, 1995. Alaska Department of Fish and Game, Fishery Data Series No. 97-3, Anchorage.

The Alaska Department of Fish and Game administers all programs and activities free from discrimination on the basis of sex, color, race, religion, national origin, age, marital status, pregnancy, parenthood, or disability. For information on alternative formats available for this and other department publications, contact the department ADA Coordinator at (voice) 907-465-4120, or (TDD) 907-465-3646. Any person who believes s/he has been discriminated against should write to: ADF&G, PO Box 25526, Juneau, AK 99802-5526; or O.E.O., U.S. Department of the Interior, Washington, DC 20240.

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	iii
LIST OF FIGURES	iv
LIST OF APPENDICES.....	v
ABSTRACT	1
INTRODUCTION.....	1
OBJECTIVES.....	5
Escapement.....	5
Commercial Harvest Assessment.....	5
METHODS.....	5
Study Design.....	5
Data Collection.....	6
Stocking and Marking.....	6
Escapement.....	6
Commercial Harvest Sampling	7
Northern District.....	8
Central District.....	8
Data Analysis.....	9
Straying.....	9
Estimating Commercial Harvest of Stocked Coho Salmon.....	9
RESULTS.....	12
Escapement.....	12
Straying.....	13
Commercial Harvest of Stocked Coho Salmon.....	13
Returns.....	28
Marine Survival	31
DISCUSSION.....	31
Sport Fishery.....	31
Escapement.....	33
Straying.....	33
Tag Loss	33
Commercial Catch Assessment.....	34
ACKNOWLEDGMENTS	35
LITERATURE CITED.....	36
APPENDIX A. SUMMARY OF CODED WIRE TAGGING DATA BY RELEASE SITE FOR COHO SALMON REARED AT BIG LAKE, ELMENDORF, AND FORT RICHARDSON HATCHERIES AND STOCKED IN NORTHERN COOK INLET, 1992-1994.....	39

TABLE OF CONTENTS (Continued)

	Page
APPENDIX B. COHO SALMON ESCAPEMENT COUNTS AT SHIP, BIRD, AND CAMPBELL CREEKS AND SELECTED TURNAGAIN ARM STREAMS	43
APPENDIX C. ESTIMATES BY RELEASE SITE OF COHO SALMON STOCKED IN 1992, 1993, AND 1994 THAT WERE HARVESTED IN UPPER COOK INLET COMMERCIAL FISHERIES IN 1995	49

LIST OF TABLES

Table	Page
1. Number of coded wire tagged coho salmon sampled (n) and tag retention (%) at release and recovery in Northern Cook Inlet escapements, 1995.....	11
2. Summary of coho salmon weir counts and sampling efforts in monitored Northern Cook Inlet streams, 1995.....	12
3. Estimated hatchery and natural contributions to total coho salmon runs into Northern Cook Inlet stocked streams.....	14
4. Number of coho salmon with decodable coded wire tags recovered from monitored Northern Cook Inlet escapements by release site, 1995.....	15
5. Commercial salmon harvest in Upper Cook Inlet, 1995.....	16
6. Commercial coho salmon harvest, harvest dates, and sampling dates for sampled Upper Cook Inlet fisheries, 1995.....	17
7. Harvest, sampling data, and coded wire tag recoveries for selected Upper Cook Inlet commercial coho salmon fisheries, 1995.....	19
8. Estimated harvest (n) and standard error (SE) of coho salmon stocked in Northern Cook Inlet streams by sampled Upper Cook Inlet Central District commercial fisheries, 1995.....	20
9. Estimated harvest (n) and standard error (SE) of coho salmon stocked in Northern Cook Inlet streams by sampled Upper Cook Inlet Northern District commercial fisheries, 1995.....	21
10. Estimated harvest (n) and standard error (SE) of Northern Cook Inlet hatchery produced coho salmon by release year in sampled commercial fisheries, 1995.....	23
11. Estimated harvest (n) and standard error (SE) of coho salmon stocked in Northern Cook Inlet streams by sampled Upper Cook Inlet commercial fisheries, 1995.....	27
12. Estimated marine survival of coho salmon stocked into four Northern Cook Inlet streams, 1995.....	32

LIST OF FIGURES

Figure	Page
1. Map of Upper Cook Inlet commercial salmon fishing districts and statistical areas.	2
2. Map of Northern Cook Inlet urban areas, with streams stocked with coho salmon in 1995 highlighted.	3
3. Distribution of coho salmon harvest and hatchery contribution among three Upper Cook Inlet fisheries: Central District drift net (CDD), Central District setnet (CDS), and Northern District setnet (NDS), 1995.	18
4. Portion of 1995 Upper Cook Inlet coho salmon commercial harvest represented by urban stocked fish.	22
5. Portion of 1995 Central District drift net coho salmon commercial harvest represented by urban stocked fish.	24
6. Portion of 1995 Central District, Upper Subdistrict setnet coho salmon commercial harvest represented by urban stocked fish.	25
7. Portion of 1995 Northern District setnet coho salmon commercial harvest represented by urban stocked fish.	26
8. Distribution of coho salmon total returns among commercial and sport fisheries and the escapement in four stocked streams.	29
9. Sport harvest and effort from 1988 to 1995 in Anchorage urban streams stocked with coho salmon.	30

LIST OF APPENDICES

Appendix	Page
A1. Summary of coded wire tagging data by release site for coho salmon reared at Big Lake, Elmendorf, and Fort Richardson hatcheries and stocked in Northern Cook Inlet, 1992.	40
A2. Summary of coded wire tagging data by release site for coho salmon reared at Big Lake, Elmendorf, and Fort Richardson hatcheries and stocked in Northern Cook Inlet, 1993.	41
A3. Summary of coded wire tagging data by release site for coho salmon reared at Elmendorf and Fort Richardson hatcheries and stocked in Northern Cook Inlet, 1994.	42
B1. Coho salmon escapement counts in Ship Creek, 1995.	44
B2. Coho salmon escapement counts from foot surveys in Bird and Campbell creeks, 1995.	46
B3. Salmon escapement counts from aerial surveys in selected Turnagain Arm streams, 1994 and 1995.	47
C1. Estimates (n) and standard error (SE) of coho salmon stocked in 1992 by release site in Upper Cook Inlet Central District drift net (244-00, 245-00) commercial harvest, 1995.	50
C2. Estimates (n) and standard error (SE) of coho salmon stocked in 1992 by release site in Upper Cook Inlet Northern District Susitna Flats/Point MacKenzie (247-41, 247-42) setnet commercial harvest, 1995.	51
C3. Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District drift net (244-00, 245-00) commercial harvest, 1995.	52
C4. Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District Ninilchik Beach (244-21) setnet commercial harvest, 1995.	53
C5. Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District Cohoe Beach (244-22) setnet commercial harvest, 1995.	54
C6. Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District Kalifornski Beach (244-30) setnet commercial harvest, 1995.	55
C7. Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District Salamatof Beach (244-40) setnet commercial harvest, 1995.	56
C8. Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Northern District westside (247-10, 247-20, 247-30) setnet commercial harvest, 1995.	57
C9. Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Northern District Susitna Flats/Point MacKenzie (247-41, 247-42) setnet commercial harvest, 1995.	58
C10. Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Northern District Fire Island (247-43) setnet commercial harvest, 1995.	59
C11. Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Northern District eastside (247-70, 247-80, 247-90) setnet commercial harvest, 1995.	60
C12. Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District drift net (244-00, 245-00) commercial harvest, 1995.	61
C13. Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District Ninilchik Beach (244-21) setnet commercial harvest, 1995.	62
C14. Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District Cohoe Beach (244-22) setnet commercial harvest, 1995.	63
C15. Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District Kalifornski Beach (244-30) setnet commercial harvest, 1995.	64
C16. Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District Salamatof Beach (244-40) setnet commercial harvest, 1995.	65
C17. Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Northern District westside (247-10, 247-20, 247-30) setnet commercial harvest, 1995.	66
C18. Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Northern District Susitna Flats/Point MacKenzie (247-41, 247-42) setnet commercial harvest, 1995.	67

LIST OF APPENDICES (Continued)

Appendix

Page

C19.	Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Northern District Fire Island (247-43) setnet commercial harvest, 1995.	68
C20.	Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Northern District eastside (247-70, 247-80, 247-90) setnet commercial harvest, 1995.	69

ABSTRACT

Juvenile coho salmon *Oncorhynchus kisutch* reared in hatcheries and released into several Northern Cook Inlet freshwater systems in 1992, 1993, and 1994 returned to Upper Cook Inlet in 1995. Some fish in each release group were marked with an adipose finclip and a coded wire tag. Marked coho salmon were recovered in 1995 from selected commercial fisheries and escapements, most of which were from 1994 releases. Fish were sampled from escapements to assess straying and long-term tag retention after release. Recoveries of marked fish from Upper Cook Inlet (UCI) commercial harvests were used to estimate harvest of hatchery-produced coho salmon.

In 1995 the UCI mixed-stock commercial fisheries harvested 446,954 coho salmon. The majority of coho salmon were harvested in the Central District drift gillnet fishery (241,473), the Northern District set gillnet fishery (89,300), and the Central District Upper, Lower, Kalgin Island, Kustatan, and Chinitna Bay Subdistricts (westside) set gillnet fishery (71,431). This project concentrated sampling efforts on coho salmon harvested in the Central District drift gillnet fishery, the Northern District set gillnet fishery, and the Central District Upper Subdistrict (eastside) set gillnet fishery. Budgetary and time constraints prevented sampling of all Central District set gillnet fisheries. Other components of this program deal with recovery of marked wild stock coho salmon from the Kenai River. Since coho salmon of Kenai River origin are known to return along the Central District eastside beaches, sampling was conducted on coho salmon harvested in the Central District Upper Subdistrict (eastside) set gillnet fishery. Coho salmon from the hatchery stocking programs contributed an estimated 12,676 (SE = 329) fish to the Central District driftnet fishery, 1,062 (SE = 173) to the Central District eastside setnet fishery, and 5,292 (SE = 201) to the Northern District setnet fishery.

An escapement of 858 coho salmon into Ship Creek exceeded the biological escapement goal of 200 coho salmon. Estimates of effort, harvest, and catch from the Statewide Harvest Survey increased in 1995 relative to the prestocking 5-year average at Ship, Campbell, and Bird creeks, likely due to the return of stocked coho salmon. Recovery of 215 coho salmon with decodable tags from escapements to Northern Cook Inlet streams indicated that straying of stocked coho salmon was not significant ($P < 0.05$) in any of the sampled streams. Only one (0.7%) of 136 tags recovered from the Ship Creek coho salmon escapement was from a fish not stocked into Ship Creek; therefore, straying into Ship Creek was likely $< 5\%$.

Key words: coho salmon, *Oncorhynchus kisutch*, commercial harvest, sport harvest, escapement, coded wire tag, Northern Cook Inlet, stocking, straying.

INTRODUCTION

Upper Cook Inlet (UCI) includes all waters of Cook Inlet north of a line at the latitude of Anchor Point light. Coho salmon *Oncorhynchus kisutch* stocks are distributed throughout UCI and support large commercial and sport harvests. In 1995, approximately 28% of the total central region commercial harvest (ADF&G 1996) and 39% of the total statewide sport harvest (Howe et al. 1996) of coho salmon occurred in UCI. The primary UCI coho salmon commercial fisheries are: (1) Central District drift gillnet, (2) Central District Upper Subdistrict (eastside) set gillnet, and (3) Northern District set gillnet fisheries (Figure 1). The most popular directed sport fisheries in UCI are: Kenai River on the Kenai Peninsula, Susitna and Little Susitna rivers in Northern Cook Inlet, and Ship Creek in the Anchorage area (Howe et al. 1996).

The Northern Cook Inlet (NCI) urban area extends from Ingram Creek in Turnagain Arm north to the Little Susitna River drainage (Figure 2). Recreational fishing effort in this area increased from an average of about 188,600 angler-days from 1978-1986 to nearly 275,000 angler-days annually from 1987-1995 (Mills 1979-1994, Howe et al. 1995 and 1996). Anglers fishing in NCI target five species of Pacific salmon *Oncorhynchus*, rainbow trout *O. mykiss*, Dolly Varden *Salvelinus malma*, Arctic grayling *Thymallus arcticus*, and northern pike *Esox lucius*. Sport fisheries for these species are supported by a combination of wild and hatchery-produced stocks.

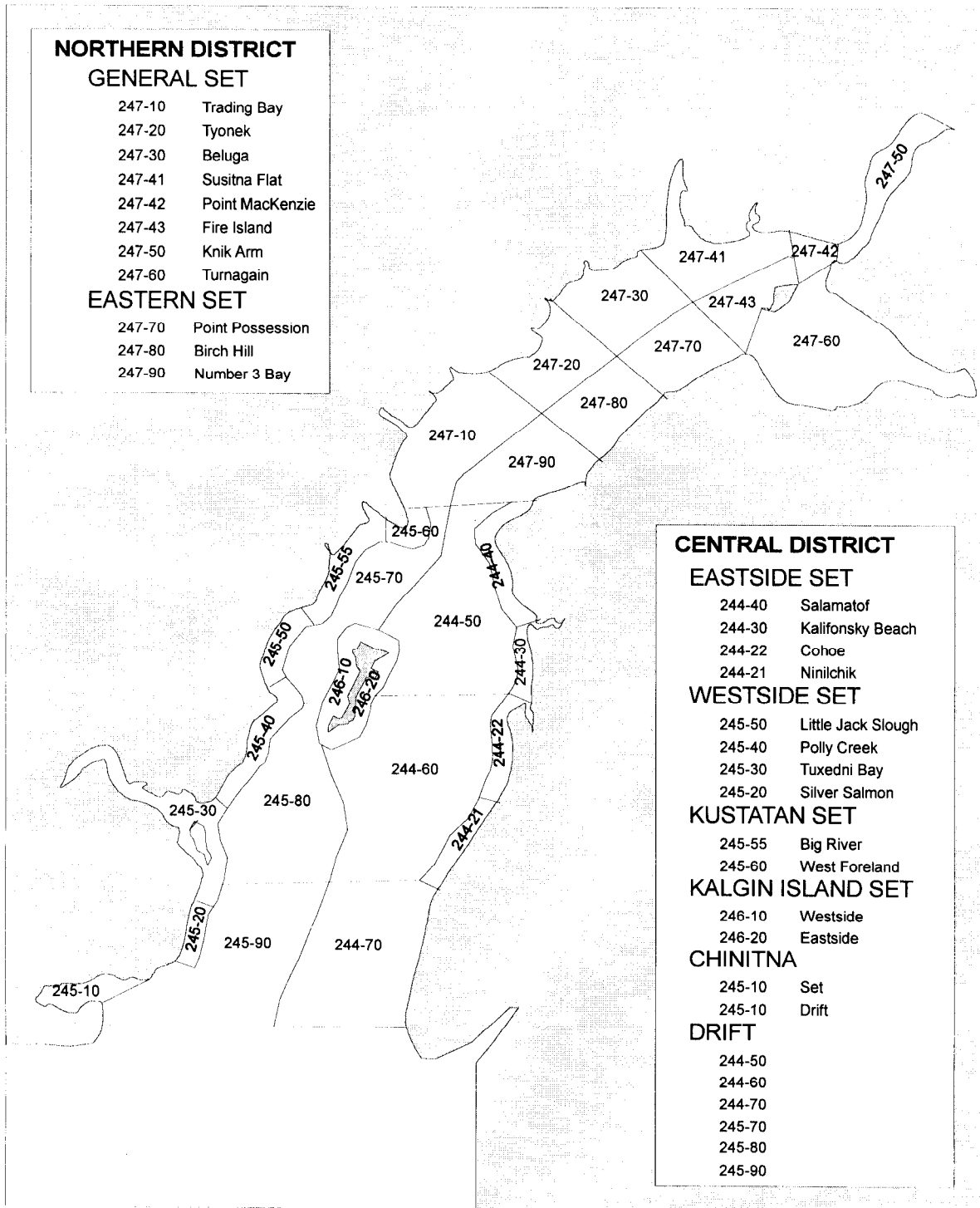


Figure 1.-Map of Upper Cook Inlet commercial salmon fishing districts and statistical areas.

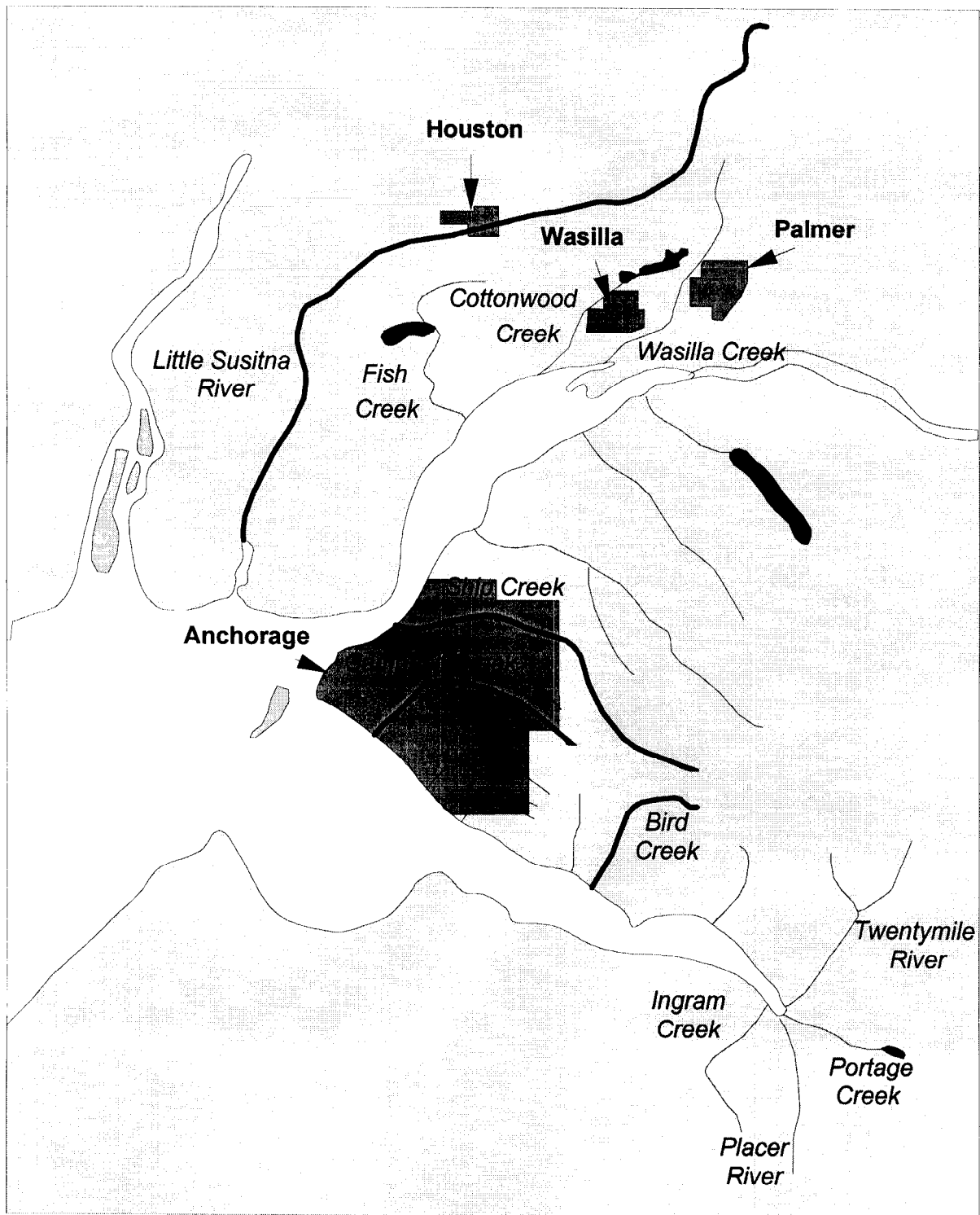


Figure 2.-Map of Northern Cook Inlet urban areas, with streams stocked with coho salmon in 1995 highlighted.

As the NCI human population grows, the demand for sport fishing opportunities increases. Hatchery-produced stocks play an important role in supporting these growing sport fisheries as wild stocks become fully utilized. While anadromous fish have been stocked in NCI waters since the 1970s, the first successful hatchery-produced fishery was not developed until the mid 1980s in Ship Creek. A coho salmon smolt stocking program was initiated in 1992 to increase recreational sport fishing opportunities in the NCI urban area. The goal was to create or enhance terminal sport fisheries in selected NCI urban area streams and attract additional recreational fishing participation. To succeed, the stocking program must be cost-effective, have minimal impact on wild stocks and/or other fisheries, and maintain historic levels of natural spawning escapements in stocked streams.

The original stocking program included seven NCI streams: Little Susitna River and Fish, Cottonwood, Wasilla, Ship, Campbell, and Bird creeks. Cottonwood, Fish, and Wasilla creeks were stocked for 2 years with coho salmon smolt reared at the Alaska Department of Fish and Game (ADF&G) Big Lake Hatchery. This facility closed in 1993, reducing the scope of the stocking program to the remaining four systems. Little Susitna River, Ship, Campbell, and Bird creeks are stocked with coho salmon smolt reared at ADF&G's Fort Richardson Hatchery. The program is targeted to increase recreational angler effort by 25,000 angler-days and harvest by 10,000 coho salmon among all streams. The Statewide Harvest Survey (SWHS) is used to evaluate increases in angler effort and harvest. During each year a portion of the smolt released into each stream are marked with an adipose finclip and a coded wire tag unique to each stream (Appendices A1-A3, Peltz and Starkey 1993, Peltz and Hansen 1994, Starkey et al. 1995).

Prior to the start of this program in 1992, no comprehensive coho salmon stock assessment program existed in NCI despite the importance of this area to UCI sport and commercial fisheries. While limited harvest information was available, there was no quantifiable information of stock composition from the mixed-stock commercial harvests and virtually no information on the magnitude of inriver runs or spawning escapements. To provide information needed to manage these fisheries, an assessment program was initiated in 1991 to evaluate coho salmon stocks in UCI (Meyer et al. *Unpublished*). This program was designed to estimate harvest of selected wild and hatchery-reared coho salmon stocks in major UCI commercial fisheries and to evaluate the success of the coho salmon hatchery stocking programs in NCI. The overall program consists of four distinct but interrelated components: (1) estimation of commercial and inriver sport harvest and escapement of coho salmon stocked in NCI streams; (2) marking of wild stock juvenile coho salmon, inriver recovery of marked adults, and estimation of UCI commercial harvests of wild stock coho salmon from Kenai River; (3) estimation of sport harvest and escapement, and evaluation of the coho salmon stocking program at Little Susitna River; and (4) production, marking, and release of coho salmon smolt by the hatcheries.

This report focuses on the first component above and primarily on results of coho salmon stocked in 1994 that returned to UCI in 1995. The remaining three program components are reported elsewhere (Carlson and Hasbrouck 1993; Carlson and Hasbrouck 1996; Bartlett 1996a; Bartlett 1996b; Peltz and Starkey 1993; Peltz and Hansen 1994; Starkey et al. 1995; Starkey et al. 1996). In 1995 the NCI coho salmon project was in its third year. Results from 1993 and 1994 programs can be found in Hoffmann and Hasbrouck (1994), and Stratton et al. (1996).

OBJECTIVES

Objectives for the 1995 urban coho salmon assessment fall into two categories: escapement and commercial catch sampling.

ESCAPEMENT

1. Enumerate coho salmon spawning escapements through a weir at Ship Creek and collect heads from a proportion of coho salmon missing their adipose fin.
2. Test the null hypothesis that hatchery-produced coho salmon stocked into Campbell Creek do not stray into Ship Creek upon return.
3. Estimate coho salmon spawning escapements in Bird and Campbell creeks using foot surveys, and selected Twentymile and Placer river drainages, and Portage Creek tributaries using a combination of foot and aerial surveys.

COMMERCIAL HARVEST ASSESSMENT

4. Estimate harvest in the Northern District setnet fishery, the Central District Upper Subdistrict (eastside) setnet fishery, and the Central District driftnet fishery of hatchery-produced coho salmon stocked into NCI urban streams.

Data collected from other components of the overall UCI coho salmon assessment program are also pertinent to this project. Coho salmon were examined for missing adipose fins from the escapement and sport harvest at Little Susitna River. Data collected from this project were used in this report to assess straying. Results of the coho salmon hatchery stocking program in Little Susitna River can be found in Bartlett (1996a), and Bartlett (1996b).

METHODS

STUDY DESIGN

The overall goals of the urban stocking program are: (1) to increase angler participation in Little Susitna River and Bird, Campbell, and Ship creeks through increased sport fishing opportunities for coho salmon, and (2) increase harvest of coho salmon in these streams. The SWHS is used to determine if targeted increases in angler effort and harvest are achieved.

This project is designed to estimate the harvest in the UCI mixed-stock commercial fishery of hatchery-produced coho salmon stocked into NCI streams and to estimate the total run of stocked fish to Bird, Ship, and Campbell creeks. Survival of hatchery-reared coho salmon from smolt to adult is estimated. Data from this project are also used by hatchery staff to assess the impact of smolt production and release on the marine survival of smolt.

The basic study design involved marking coho salmon smolt by inserting a coded wire tag into their snout and removing their adipose fin. Marked fish were released with unmarked fish into each stream in 1992, 1993, and 1994 and emigrated to marine waters. Catch sampling programs of adult coho salmon in the commercial harvest and the escapement were conducted in 1995 to recover marked fish. Heads were collected from coho salmon missing the adipose fin and sent to the ADF&G Coded Wire Tag Laboratory (Tag Lab) in Juneau. The Tag Lab determined if a tag was present and decoded recovered tags to determine year and stream of release. Catch sampling data were used to test assumptions of the model to estimate harvest of marked cohorts and to

determine the stratification necessary to provide an unbiased estimate of harvest with the best precision. Final estimates of harvest and their variances were then calculated.

DATA COLLECTION

Stocking and Marking

Coho salmon from Little Susitna River were used as brood stock for hatchery releases into Bird and Campbell creeks and Little Susitna River. Gametes collected from coho salmon near Nancy Lake were fertilized, then incubated, and the resultant fry reared at ADF&G's Fort Richardson Hatchery. Coho salmon from Ship Creek were used as brood stock for stocking in Ship Creek and reared at ADF&G's Elmendorf Hatchery. Coho salmon of Fish Creek origin were used as brood stock for stocking in Cottonwood, Fish, and Wasilla creeks. Embryos were collected and reared at Big Lake Hatchery. Gametes collected in 1990 produced coho salmon smolt that were stocked in 1992 (Peltz and Starkey 1993). The majority of these fish returned as adults in 1993, however, coho salmon stocked into Cottonwood, Fish, and Wasilla creeks in 1992 returned primarily in 1994, and a few coho salmon stocked into Cottonwood and Fish creeks in 1992 returned in 1995. Gametes collected in 1991 produced coho salmon smolt that were stocked in 1993 (Peltz and Hansen 1994) and returned as adults primarily in 1994 with some 1993 stocked smolt returning in 1995. Gametes collected in 1992 produced coho salmon smolt that were stocked in 1994 (Starkey et al. 1995) and returned as adults in 1995.

A portion of smolt from each release cohort were marked with an adipose finclip and a uniquely numbered coded wire tag inserted in their snout. While the tagging goal of 40,000 smolt per release stream was not met for all releases in 1992, the targeted fraction marked (30%) was generally exceeded (Appendix A1, Peltz and Starkey 1993). The tagging goal of 40,000 smolt per release stream was exceeded for all releases in 1993 and 1994 (Appendix A2, Peltz and Hansen 1994, Appendix A3, Starkey et al. 1995). The cohorts recovered primarily in 1995 originated from 1994 releases and ranged from 75,779 smolt released into Ship Creek to 126,694 smolt released into Little Susitna River (Appendix A3). Details of the rearing, marking, and release of hatchery-stocked coho salmon are discussed in detail by Peltz and Starkey (1993), Peltz and Hansen (1994), and Starkey et al. (1995).

Escapement

A fish pass with a live box, hereafter called a weir, was used to enumerate Ship Creek's coho salmon escapement. The weir was located above the instream sport fishery and the total number of coho salmon passed through the weir was assumed to equal the entire escapement. The Ship Creek weir was operated from 14 May through 20 September with the first coho salmon passing through the weir on 17 July (Appendix B1). The weir was in operation 24 hours a day on the days it was open. Counts of all coho salmon passing the weir were made at least once per day; all coho salmon that entered the live box were examined for a missing adipose fin. Counts of other salmon species were recorded. The weir was closed from 2 September through 5 September and from 9 September through 11 September once the biological escapement goal (BEG) was reached and an emergency order was issued increasing the bag limit on coho salmon.

Heads were collected from some of the coho salmon with missing adipose fins that passed through the Ship Creek weir to test the straying hypothesis. A BEG has been set at 200 naturally spawning coho salmon for Ship Creek. Given the expected number of coho salmon in the escapement and the need to collect a minimum of 60 coho salmon with coded wire tags to test

the hypothesis of straying, heads were systematically collected from every second coho salmon missing the adipose fin at Ship Creek. As the Ship Creek coho salmon run peaked the number of heads collected decreased to every fourth fish. This level of sampling allowed us to test the straying hypothesis while ensuring that the BEG would be met. A uniquely numbered cinch strap was affixed to the jaw of each coho salmon head collected. Each head was placed in an individual clear plastic bag with the cinch strap number visible. Collected data included: date, creek, number of coho salmon examined, number of coho salmon missing the adipose fin, number of heads collected from coho salmon missing their adipose fin, and the cinch strap number of each head collected. All heads with cinch straps were returned to the Anchorage ADF&G office and frozen until shipment to the Tag Lab.

A weir was operated on Little Susitna River (Bartlett 1996b) to enumerate coho salmon escapement and examine coho salmon for missing adipose fins. Data collected from this project were also used to assess straying.

Foot surveys were used to estimate coho salmon escapements in Bird and Campbell creeks in the Anchorage urban area. A combination of foot and aerial surveys were conducted to estimate wild stock coho salmon escapements in selected Twentymile and Placer river drainages and selected Portage Creek tributaries in Turnagain Arm south of Anchorage (Appendix B3).

Commercial Harvest Sampling

Sampling of the UCI commercial coho salmon harvest was conducted from mid-July to early September 1995. Coho salmon were sampled on sorting lines at processors, at buying stations, or on-board tenders. All regular commercial fishing periods (7:00 a.m. to 7:00 p.m., Mondays and Fridays) that occurred from mid-July through early September in the Central District driftnet and eastside setnet fisheries and the Northern District setnet fishery were sampled (Figure 1). Additional Central District fishing periods were sampled as time and budget allowed.

Coho salmon delivered to processors, buying stations, or tenders were counted and examined for the absence of the adipose fin. As many fish as possible were examined from deliveries during the sampling shift. All coho salmon observed with a missing adipose fin were retrieved, the head removed, and a uniquely numbered cinch strap affixed to the head. Each head was placed in an individual clear plastic bag with the cinch strap number visible. Collected data included: date of harvest, date of sampling, processor, delivery location, name of tender or buying station, statistical area, number of coho salmon examined, number of coho salmon missing their adipose fin, number of heads collected from coho salmon missing their adipose fin, and the cinch strap number of each head collected. All coho salmon heads with cinch straps were returned to ADF&G offices in Soldotna or Anchorage. The heads were frozen and shipped weekly to the Tag Lab for tag removal and decoding. After each commercial fishing period, the preliminary commercial harvest of coho salmon in UCI by statistical area was obtained from Division of Commercial Fisheries Management and Development (CFMD) staff in Soldotna. Final commercial harvest data by statistical area and date were obtained on 25 January 1996.

In general, totes sampled from setnet harvested coho salmon were pure loads of fish harvested from a single statistical area. Thus, for samples from setnet harvested coho salmon the total number of coho salmon harvested, the number examined, and the number with a missing adipose fin from each statistical area was assumed known. Totes of coho salmon sampled from the Central District driftnet fishery were a mixture of fish harvested in different statistical areas.

Thus, the same data (except statistical area) existed for coho salmon harvested in the Central District driftnet fishery but, because sampled coho salmon were from a mixture of statistical areas, the harvests from statistical areas 244-50, 244-60, 244-70, 245-70, 245-80, and 245-90 were summed.

Northern District

The Northern District is subdivided into 11 statistical areas (Figure 1). By regulation, commercial fishing periods occur between 7:00 a.m. and 7:00 p.m. on Mondays and Fridays from 25 June until closed by emergency order (5 AAC 21.320, *Weekly Fishing Periods*). Additional fishing periods are allowed and/or regularly scheduled periods may be closed by emergency order; however, no additional fishing periods may be allowed after 15 August (5 AAC 21.363, *Upper Cook Inlet Management Plan*). Only set gillnet gear is allowed in Northern District waters (5 AAC 21.330, *Gear*). Statistical area 247-50 is only opened through emergency order (5 AAC 21.364, *Fish Creek Sockeye Salmon Management Plan*) and statistical area 247-60 is closed to commercial fishing (5 AAC 21.350, *Closed Waters*).

Coho salmon processed in the Anchorage area during 1995 were comprised entirely of fish harvested in Northern District statistical areas. Three technicians and one student intern stationed in Anchorage sampled commercial harvests with efforts concentrated at two shorebased processors, Whitney Foods and North Alaska Fisheries. Additional sampling was periodically conducted on-board their tenders. Setnet harvests purchased by Cook Inlet Processors in Nikiski were sampled regularly by personnel from Soldotna for statistical areas 247-70, 247-80, and 247-90. Some coho salmon harvested from statistical areas 247-10, 247-20, and 247-30 were sampled at Icicle Seafoods in Homer by Soldotna-based technicians. Objectives were to sample 35% of the harvest of each Northern District statistical area. Harvest from the Northern District was sampled in Anchorage and Homer from 17 July through 21 August when all processors closed for the season. Sampling was conducted at Cook Inlet Processors from 31 July until 4 September. Technicians contacted the processors throughout the season to coordinate sampling logistics and to ensure that all possible fish were examined.

Central District

Three commercial gear types are used in the Central District: drift gillnet, set gillnet, and seine gear (allowed in Chinitna Bay). The Central District driftnet fleet operates in seven statistical areas and the setnet fishery occurs in 13 statistical areas (Figure 1). Coho salmon harvested by driftnet were sampled from six statistical areas (244-50, 244-60, 244-70, 245-70, 245-80, and 245-90) and those harvested by set net were sampled from four statistical areas (244-21, 244-22, 244-30, and 244-40) composing the Upper Subdistrict (eastside) fishery.

Commercial fishing periods of both the driftnet and Upper Subdistrict setnet fisheries occur between 7:00 a.m. and 7:00 p.m. on Mondays and Fridays (5 AAC 21.320, *Weekly Fishing Periods*). Additional fishing periods are allowed through emergency order and regularly scheduled periods may be closed by emergency order. The *Upper Cook Inlet Management Plan* (5 AAC 21.363) restricts the dates of the setnet fishery from 1 July through 15 August. Several management plans affect time and area closures or openings of both fisheries (5 AAC 21.359, *Kenai River Late Chinook Salmon Management Plan*; 5 AAC 21.360, *Kenai River Sockeye Salmon Management Plan*; 5 AAC 21.361, *Russian River Sockeye Salmon Management Plan*; 5 AAC 21.363, *Upper Cook Inlet Management Plan*; and 5 AAC 21.365, *Kasilof River Sockeye Salmon Special Harvest Area Management Plan*).

Most coho salmon harvested from the Central District driftnet and Upper Subdistrict setnet fisheries as well as some coho salmon harvested by Northern District setnet fisheries are processed at facilities on the Kenai Peninsula. Commercial catch sampling of these coho salmon harvests was conducted under the supervision of CFMD biologists in Soldotna. Sampling of the driftnet harvest occurred at Carlson Seafoods, Cook Inlet Processing, Dragnet Fisheries, Icicle Seafoods, Inlet Fisheries, Pacific Star, Royal Pacific Fisheries, Salamatof Seafoods, Snug Harbor Seafoods, Trans-Aqua International, Wards Cove Packing, and Seasonal Seafoods. The Upper Subdistrict setnet harvest was sampled at buying stations of major fish processors. These processors included: Cook Inlet Processing, Deep Creek, Dragnet Fisheries, Fishhawk Fisheries, Icicle Seafoods, Inlet Fisheries, Pacific Star, R & J Seafoods, Royal Pacific Fisheries, Salamatof Seafoods, Snug Harbor, Trans-Aqua International, Wards Cove Packing, Whitney Seafoods, and Seasonal Seafoods.

The driftnet harvest was sampled by six technicians from 7 July through 28 August. The harvest of the Upper Subdistrict setnet fishery was sampled by four technicians from 14 July until the fishery closed on 14 August.

DATA ANALYSIS

Straying

The potential for hatchery-reared and released anadromous fish to stray from stream of release into a different stream upon return exists. Therefore, a null hypothesis that stocked coho salmon did not stray from the stream of stocking upon return was included in this project. A chi-square statistic was used to test the null hypothesis such that a stray rate of 0.05 could be detected 95% of the time at $\beta = 0.05$. Only recoveries from the Ship Creek escapement were used for this test. A sample size of at least 60 decodable tags from heads collected at the Ship Creek weir was sufficient for this test. If all 60 tagged coho salmon recovered at the weir were originally stocked in Ship Creek, then the straying rate was likely $< 5\%$. If one or more of the 60 tagged coho salmon was stocked into a different creek, then the straying rate was likely $\geq 5\%$.

Estimating Commercial Harvest of Stocked Coho Salmon

Estimating the commercial harvest of a cohort required determining the proportion of fish marked with a coded wire tag and adipose finclip. The proportion of tagged coho salmon stocked at each location was assumed known prior to release (Peltz and Starkey 1993, Peltz and Hansen 1994, Starkey et al. 1995). However, if significant tag loss occurred after release the proportion of tagged coho salmon was estimated by sampling the inriver return of adults.

A chi-square statistic was used to test the hypothesis that tag retention at return and release was the same. Tag retention data prior to smolt release and adult recovery data from Ship Creek and Little Susitna River escapements were used for the test. Data from the releases at Nancy Lake were pooled to estimate tag retention at release of fish stocked into Little Susitna River.

Harvest of a single marked cohort (release group) of fish in a stratum was estimated by (Clark and Bernard 1987, Bernard and Clark *In press*):

$$\hat{n}_1 = N\theta^{-1} \left(\frac{a_1 m_1 m_c}{a_2 m_2 n_2} \right) = N\theta^{-1} \hat{p}, \quad (1)$$

where:

N	=	total number of fish in the harvest,
θ	=	proportion of the cohort marked and released with a coded wire tag,
a_1	=	number of fish in the sample missing their adipose fin,
a_2	=	number of heads sampled from fish missing their adipose fin that arrived at the Tag Lab,
m_1	=	number of heads with coded wire tags detected,
m_2	=	number of coded wire tags found and decoded,
m_c	=	number of decoded coded wire tags from the cohort, and
n_2	=	number of fish in the harvest examined for a missing adipose fin.

This estimator is statistically unbiased when sampling is from a simple random or pseudo-random process (Clark and Bernard 1987).

If tag retention at return was not statistically different from tag retention at time of release, the proportion of marked coho salmon in each cohort at time of release was treated as a known constant. When the harvest (N) and the proportion marked (θ) are known without error an unbiased estimate of the variance is:

$$V(\hat{n}_1) = \left[\left(\frac{m_2}{m_2 - 1} \right) \left(\frac{m_1 - 1}{m_1} \right) \left(\frac{a_2}{a_2 - 1} \right) \left(\frac{a_1 - 1}{a_1} \right) \left(\frac{n_2}{n_2 - 1} \right) \left(\frac{N - 1}{N} \right) \right] \left[m_c \left(\frac{Nm_1a_1}{m_2a_2n_2\theta} \right)^2 \right] \times \left[1 - m_c + \left(\frac{(m_2 - 1)(a_2 - 1)(n_2 - 1)}{(m_1 - 1)(a_1 - 1)(N - 1)} \right) \left(\frac{m_1a_1Nm_c}{m_2a_2n_2} - \theta \right) \right]. \quad (2)$$

Values of harvest from the fish ticket database are assumed known and measured without error. We found a statistically significant difference in tag retention (Table 1) between 1994 releases from the hatchery and 1995 adult escapement samples at Little Susitna River ($\chi^2 = 5.25$, $df = 1$, $P = 0.022$). No significant differences were found in tag retention between 1994 releases from the hatchery and 1995 adult escapement samples at Ship Creek ($\chi^2 = 0.22$, $df = 1$, $P = 0.64$). We concluded that the difference in tag retention estimates at Little Susitna River were too small to be of biological significance or lead to biased estimates of commercial harvest of this cohort, and that the statistical results were a function of the large sample size of marked coho salmon examined at the hatchery. The values of θ at the time of release (Peltz and Starkey 1993, Peltz and Hansen 1994, Starkey et al. 1995) were used and treated as known values measured without error for 1994 releases into Little Susitna River and Ship, Bird, and Campbell creeks.

One cohort of coho salmon, those released into Little Susitna River in 1993, had significant tag loss after release. For coho salmon stocked into Little Susitna River in 1993, the proportion of

Table 1.-Number of coded wire tagged coho salmon sampled (n) and tag retention (%) at release and recovery in Northern Cook Inlet escapements, 1995.

Release Site	Release ^a			Recovery		
	Year	n	%	Year	n	%
Bird Creek	1994	762	98.8	1995 ^b		
Campbell Creek	1994	785	97.3	1995 ^b		
Ship Creek	1994	839	94.8	1995	145	93.8
Little Susitna River	1994	1,590	98.5	1995 ^c	83	95.2
	1994	1,590	98.5	1995 ^d	118	93.2
	1994	1,590	98.5	1995 ^e	156	92.9

^a Starkey et al. 1995.

^b No tag recovery program.

^c Weir recoveries.

^d Egg take recoveries.

^e Sport harvest recoveries.

marked coho salmon was estimated from fish sampled during the egg take at Nancy Lake. Because stocked coho salmon smolt were released at Nancy Lake and few, if any, naturally produced coho salmon spawn in Nancy Lake, we assumed all fish sampled at the egg take were stocked coho salmon. Commercial harvest of this cohort of fish was estimated using equation 1 substituting $\hat{\theta}$ for θ . An unbiased estimate of the variance of harvest when θ is estimated is (Bernard and Clark *In press*):

$$V[\hat{n}_1] = \hat{n}_1^2 \left[G(\hat{p}) + G(\hat{\theta}^{-1}) - G(\hat{p})G(\hat{\theta}^{-1}) \right], \quad (3)$$

where:

$$G(\hat{p}) = \frac{1 - \lambda\phi\hat{\theta}}{\lambda n_2 \hat{p}},$$

$$\lambda = \frac{m_2 a_2}{m_1 a_1},$$

$$\phi = \frac{n_2}{N}, \text{ and}$$

$$G(\hat{\theta}^{-1}) = \frac{V(\hat{\theta}^{-1})}{\hat{\theta}^{-2}}.$$

Based on adult coho salmon sampled at the egg take, the estimated proportion of tagged coho salmon stocked into Little Susitna River in 1993 was $\hat{\theta} = 0.110$ and the variance of its inverse was $V(\hat{\theta}^{-1}) = 2.0517$.

Harvest of each cohort was stratified by date and statistical area for each sampled fishery. Statistical area was unknown when catch sampling the Central District driftnet fishery so harvest of this fishery was stratified only by date. The total harvest of a cohort in a fishery was estimated by summing the estimates among the strata. Variance of the total estimate was also calculated by summing the variances of the strata estimates since strata were assumed independent and there were no additional covariance terms.

Total harvest of marked cohorts and their variances were estimated with the data stratified and with the data combined to determine if data could be combined among statistical areas of setnet harvested coho salmon, particularly in the Northern District. For example, to determine if three statistical areas could be combined, estimates calculated with the data stratified by statistical area and then summed were compared to the estimate with data from the three statistical areas combined. A z-test was used to determine if there were significant differences between estimates from stratified data and data combined. If the estimates of harvest were not significantly different and combining the data improved the precision of the estimate, the data were combined. Otherwise, estimates were stratified.

RESULTS

ESCAPEMENT

In 1995, 492 of the 1,003 coho salmon counted at the weir on Ship Creek were missing their adipose fin (Table 2, Appendix B1). A total of 145 heads were collected from coho salmon missing their adipose fin and sent to the Tag Lab. The remaining 858 coho salmon were passed through the weir. A total of 2,516 coho salmon were examined for a missing adipose fin at the Little Susitna River weir and 83 heads were collected. Coho salmon escapements into Bird (139) and Campbell (1,423) creeks were estimated using foot surveys (Appendix B2). A combination of foot and aerial surveys were conducted on selected Twentymile and Placer river drainages and selected Portage Creek tributaries in Turnagain Arm to estimate wild coho salmon escapements (Appendix B3). The total Placer River drainage escapement index from ADF&G aerial surveys was 810 coho salmon, and included sloughs and Skookum Creek. ADF&G aerial surveys tallied an estimated escapement index of 987 coho salmon into Twentymile River drainage and an estimated escapement of 307 coho salmon into selected Portage Creek sloughs and streams. Foot surveys conducted by United States Forest Service personnel tallied estimated escapement indices of 35 coho salmon in Williwaw Creek, 350 coho salmon in Explorer Creek, and 10 coho salmon in the Portage Creek mainstem.

Table 2.-Summary of coho salmon weir counts and sampling efforts in monitored Northern Cook Inlet streams, 1995.

Stream	Number to Weir	Examined for missing adipose fins	Observed with missing adipose fins	Heads collected	Decodable Tags	Total Through Weir	Weir Operation Dates ^b
Little Susitna River ^a	12,266	2,516	89	83	79	12,183	7/1-9/4
Ship Creek	1,003	1,003	492	145	136	858	7/17-9/20

^a Bartlett 1996b.

^b Weir starting date is date first coho salmon was passed through weir.

The contribution of hatchery fish to the Ship Creek escapement was calculated from tag recovery data. An estimated 830 (SE = 31) coho salmon in the escapement were stocked into Ship Creek, 7 (SE = 6) were originally stocked into Campbell Creek, and the remaining 166 were from natural production (Table 3).

STRAYING

A total of 215 decodable tags were recovered from coho salmon escapements monitored at Ship Creek and the Little Susitna River (Table 4). Of the 136 coho salmon recovered with tags from the Ship Creek escapement, only one (0.7%) was from a fish not originally stocked into Ship Creek. Of the 79 coho salmon recovered with tags from Little Susitna River escapement, only one (1%) was from a fish not originally stocked into Little Susitna River. Therefore, straying of stocked coho salmon among these streams was likely < 5%. Finally, of the 968 tags recovered from the Kenai River sport harvest, two tags were from coho salmon stocked at Ship Creek (J. Carlson, ADF&G, Soldotna, personal communication).

COMMERCIAL HARVEST OF STOCKED COHO SALMON

A total of 446,954 coho salmon were harvested in the Upper Cook Inlet (UCI) mixed-stock fisheries in 1995 (Table 5). Catch sampling occurred in the Central District drift gillnet fishery excluding Chinitna Bay, the Northern District set gillnet fishery excluding Knik Arm, and the Central District Upper Subdistrict (eastside) set gillnet fishery. A combined total of 366,177 coho salmon were harvested in the sampled fisheries (Table 6). Catch sampling did not occur over the entire fishing season, however, only 7% of the overall UCI coho salmon harvest in the selected fisheries occurred on days not sampled. Harvest on days not sampled was combined with the nearest day the harvest was sampled to estimate harvest of marked cohorts for the entire season.

Approximately half of all samples collected from the commercial setnet harvest in statistical areas 247-10, 247-20, and 247-30 were mixed loads from these three areas. One of these samples also contained coho salmon harvested from 245-60, however, due to the small size of this sample, it was not used in the analysis. For the 4 days when pure loads were sampled from 247-10, 247-20, and 247-30, there was no significant difference ($|z| = 1.69$, $P = 0.09$) in the estimated harvest of coho salmon stocked into Bird, Campbell, and Ship creeks, and Little Susitna River between data stratified by statistical area or with the data combined among areas. There were not enough pure loads sampled from statistical areas 247-70, 247-80, and 247-90 in 1995 to perform a z-test to determine if significant differences existed between data stratified or data combined. Data from 247-70, 247-80, and 247-90 were combined in 1993 and 1994 when no significant difference was discovered in the estimated harvest of coho salmon stocked into Bird, Campbell, and Ship creeks, and Little Susitna River between data stratified by statistical area and data combined among areas (Hoffmann and Hasbrouck 1994, Stratton et al. 1996). Therefore, data from 247-70, 247-80, and 247-90 were combined in 1995. The majority of samples collected from statistical areas 247-41 and 247-42 were pure loads, however, several sample dates had coho harvests in one of the statistical areas while the adjacent statistical area had no harvest. For the 6 days when pure loads were sampled from 247-41 and 247-42, no significant difference ($|z| = 0.07$, $P = 0.94$) was present in the estimated harvest of the aforementioned release cohorts between data stratified by statistical area or with the data combined among the two areas. These results indicate that combining harvest and sample data

Table 3.-Estimated hatchery and natural contributions to total coho salmon runs into Northern Cook Inlet stocked streams.

Stream		Hatchery Production				Natural Production		Total Production	
		1993 releases	1994 releases	Total	Percent	Number	Percent	Number	Percent
		Number	Number						
Bird Creek	Commercial Harvest	17	4,367	4,384	50.7	unknown		4,384	50.7
	Sport Harvest	unknown	unknown	4,121	47.7	unknown		4,121	47.7
	Escapement ^a	unknown	unknown	139	1.6	unknown		139	1.6
	Total	17	4,367	8,644	100.0			8,644	100.0
Campbell Creek	Commercial Harvest	0	4,320	4,320	64.9	unknown		4,320	56.2
	Sport Harvest	unknown	unknown	1,348	20.3	599 ^b	57.8	1,947	25.3
	Escapement	unknown	unknown	985	14.8	438 ^b	42.2	1,423	18.5
	Total	0	4,320	6,653	100.0	1,037	100.0	7,690	100.0
Ship Creek	Commercial Harvest	21	2,634	2,655	42.8	unknown		2,655	38.4
	Sport Harvest ^c	13	2,704	2,717	43.8	543 ^d	76.6	3,260	47.2
	To Weir ^e	4	826	830	13.4	166	23.4	996	14.4
	Total	38	6,164	6,202	100.0	709	100.0	6,911	100.0
Little Susitna River	Commercial Harvest	121	5,711	5,832	58.8	unknown		5,832	17.9
	Sport Harvest ^f	43	2,905	2,948	29.7	11,489	50.8	14,437	44.4
	To Weir ^f	0	1,135	1,135	11.4	11,131	49.2	12,266	37.7
	Total	164	9,751	9,915	100.0	22,620	100.0	32,535	100.0

^aEstimated escapement index from foot surveys.

^bContribution of natural production is calculated using proportion of natural production to Campbell Creek weir count in 1993 and 1994.

^cContribution of 1993 and 1994 hatchery releases calculated using proportion of 1993 and 1994 releases to Ship Creek weir.

^dContribution of natural production is calculated using proportion of natural production to Ship Creek weir count.

^eTotal hatchery production estimate does not include Campbell Creek contribution of 7 coho salmon.

^fHatchery and natural contribution to Little Susitna River sport harvest and weir from Bartlett 1996b.

Table 4.-Number of coho salmon with decodable coded wire tags recovered from monitored Northern Cook Inlet escapements by release site, 1995.

Release Site	Recovery Site		Total Recoveries
	Little Susitna River ^a	Ship Creek	
Campbell Creek	0	1	1
Little Susitna	78	0	78
Ship Creek	0	135	135
Kenai River	1	0	1
Total	79	136	215

^a Bartlett 1996b.

from statistical areas 247-10, 247-20, and 247-30, combining harvest and sample data from statistical areas 247-41 and 247-42, and combining harvest and sample data from statistical areas 247-70, 247-80, and 247-90, together, will not introduce significant bias in estimating commercial harvest of marked cohorts. Combining these statistical areas in this fashion also allowed the use of sample data from mixed loads collected from these areas. Statistical areas from the Central District eastside setnet fishery were not pooled because precision of the estimates did not improve appreciably when the areas were combined. Therefore, harvest estimates of marked cohorts were stratified by statistical area and by date.

The majority of the UCI coho harvest in the sampled fisheries was taken in the Central District driftnet fishery, followed by the Northern District setnet fishery, and the Central District eastside setnet fishery (Figure 3). Similarly, most of the coded wire tags recovered (Table 7) and most of the harvest of hatchery-produced coho salmon occurred in the Central District driftnet and Northern District setnet fisheries (Tables 8 and 9, Figure 3).

Overall, stocked coho salmon represented 5.2% of the sampled UCI coho salmon commercial harvest (Figure 4, Table 10). When estimated by fishery, 5.4% of the Central District driftnet fishery, 2.4% of the Central District Eastside setnet, and 6.1% of the Northern District setnet sampled harvests were composed of hatchery-produced fish (Figures 5, 6, and 7, Table 10). The 1994 smolt releases into three Anchorage urban area streams (Bird, Campbell, and Ship creeks), and Little Susitna River were the largest contributors to the commercial harvest (Table 11). The returns of Little Susitna River 1994 stocked coho salmon composed 33.5% (5,711 coho salmon) of the hatchery returns in all sampled commercial fisheries. Coho salmon stocked into Bird and Campbell creeks in 1994 provided approximately 25% (about 4,300 coho salmon) each of hatchery returns in all sampled fisheries. Coho salmon stocked into Ship Creek in 1994 composed 15.5% (2,634 coho salmon) of hatchery returns in all of the fisheries.

Contributions to the sampled commercial fisheries from 1992 and 1993 smolt releases into Bird, Campbell, and Ship creeks and Little Susitna River can be found in Appendices C1-C11.

Most of the returning adult salmon stocked into Little Susitna River in 1994 that were harvested in sampled 1995 UCI commercial fisheries were taken by the Central District drift fleet (4,039, 71%; Appendices C12-C20). Over 80% of these fish were harvested from 17 July to 31 July.

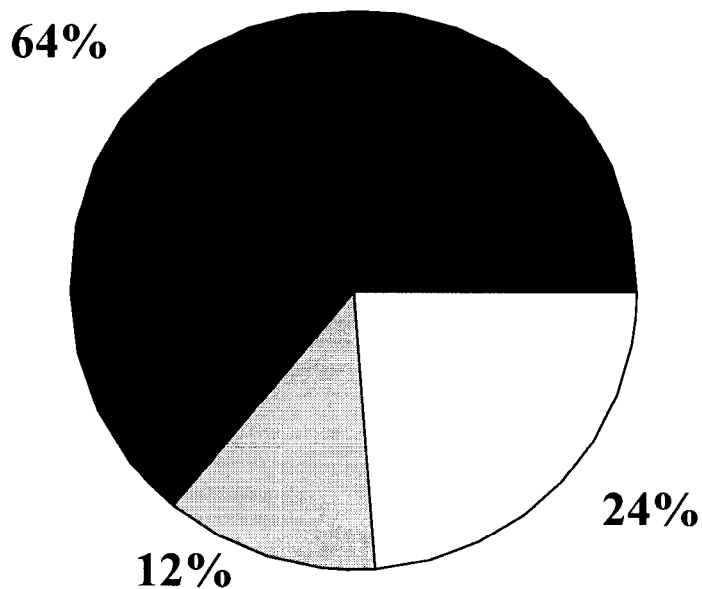
Table 5.-Commercial salmon harvest in Upper Cook Inlet, 1995.

Fishery	Statistical Area	Chinook	Sockeye	Coho	Pink	Chum	Total Catch	% Coho
Central District Drift								
General (East/West Sides)	245-70,80,90; 244-50,60,70	523	1,773,281	234,126	64,562	467,063	2,539,555	9.2%
Chinitna Bay	245-10	71	592	7,347	70	1,161	9,241	79.5%
Total		594	1,773,873	241,473	64,632	468,224	2,548,796	9.5%
Central District Set								
Westside								
Western, Kustatan	245-20,30,40,50,55,60	1,057	27,865	32,580	1,229	3,102	65,833	49.5%
Kalgin Island	246-10,20	40	78,551	35,587	1,996	784	116,958	30.4%
Chinitna Bay	245-10	4	1,224	3,264	585	9,934	15,011	21.7%
Total		1,101	107,640	71,431	3,810	13,820	197,802	36.1%
Eastside								
Ninilchik	244-21	3,221	137,398	6,376	18,437	351	165,783	3.8%
Cohoe	244-22	2,314	275,648	8,618	19,792	966	307,338	2.8%
Kalifornski	244-30	4,358	323,197	12,142	7,291	596	347,584	3.5%
Salamatof	244-40	2,139	224,973	17,614	7,900	1,798	254,424	6.9%
Total		12,032	961,216	44,750	53,420	3,711	1,075,129	4.2%
Central District total		13,727	2,842,729	357,654	121,862	485,755	3,821,727	9.4%
Northern District Set								
Westside								
Trading Bay	247-10	383	4,406	9,674	543	1,677	16,683	58.0%
Tyonek	247-20	311	13,546	24,417	1,970	10,800	51,044	47.8%
Beluga	247-30	2,396	34,156	30,964	4,426	21,819	93,761	33.0%
Susitna Flat	247-41	20	3,332	1,318	414	1,026	6,110	21.6%
Pt. MacKenzie	247-42	50	4,920	2,928	414	1,700	10,012	29.2%
Fire Island	247-43	117	6,028	6,012	945	3,242	16,344	36.8%
Knik Arm	247-50	5	19,477	1,999	72	1,018	22,571	8.9%
Total		3,282	85,865	77,312	8,784	41,282	216,525	35.7%
Eastside								
Pt. Possession	247-70	694	10,481	5,464	2,021	2,279	20,939	26.1%
Birch Hill	247-80	113	5,014	2,980	569	74	8,750	34.1%
Number 3 Bay	247-90	41	7,738	3,544	339	32	11,694	30.3%
Total		848	23,233	11,988	2,929	2,385	41,383	29.0%
Northern District setnet total		4,130	109,098	89,300	11,713	43,667	257,908	34.6%
Upper Cook Inlet total		17,857	2,951,827	446,954	133,575	529,422	4,079,635	11.0%

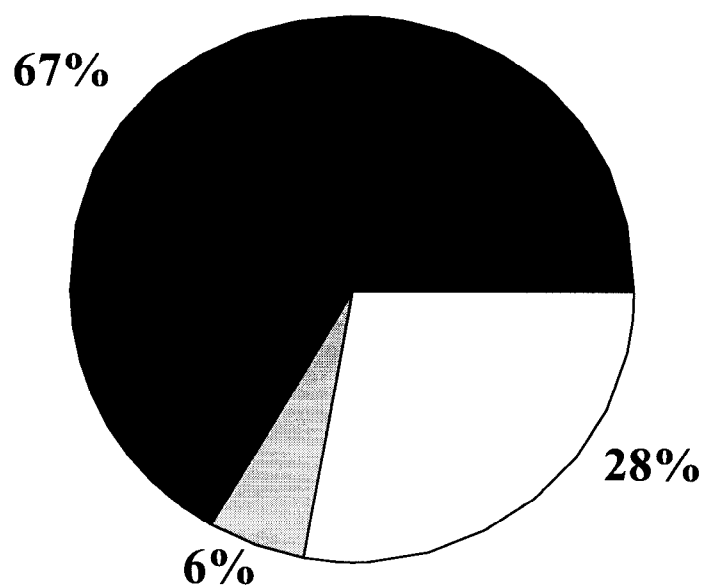
Table 6.-Commercial coho salmon harvest, harvest dates, and sampling dates for sampled Upper Cook Inlet fisheries, 1995.

Fishery	Statistical Area	Catch dates	Total Coho catch	Sampling dates	Catch during sampling	Sampled ^a
Central District Drift	244, 245	6/26-9/01	234,126	7/07-8/29	223,749	95.6%
Central District Set						
Ninilchik	244-21	7/03-8/14	6,376	7/17-8/14	5,145	80.7%
Cohoe	244-22	7/03-8/14	8,618	7/14-8/14	7,677	89.1%
Kalifornski	244-30	7/03-8/14	12,142	7/14-8/14	9,835	81.0%
Salamatof	244-40	7/03-8/14	17,614	7/14-8/14	14,727	83.6%
Eastside setnet total			44,750		37,384	83.5%
Northern District Set						
Westside	247-10,20,30	6/30-9/04	65,055	7/17-8/21	59,995	92.2%
Susitna Flats/Pt. MacKenzie	247-41,42	6/30-9/01	4,246	7/17-8/21	3,081	72.6%
Fire Island	247-43	7/03-9/04	6,012	7/17-8/21	4,605	76.6%
Eastern	247-70/80/90	6/30-9/11	11,988	7/21-9/04	10,192	85.0%
Northern setnet total			87,301		77,873	89.2%
Upper Cook Inlet total			366,177		339,006	92.6%

^a Percentage of total coho harvest represented by sampling.



Distribution of
Total Harvest



Distribution of
Hatchery
Contribution

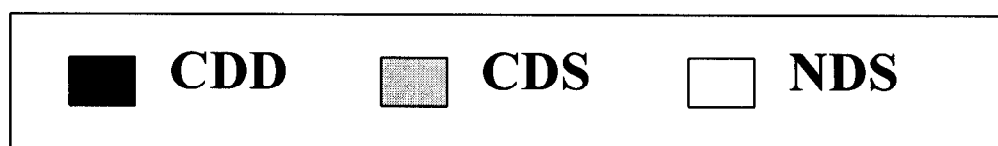


Figure 3.-Distribution of coho salmon harvest and hatchery contribution among three Upper Cook Inlet fisheries: Central District drift net (CDD), Central District setnet (CDS), and Northern District setnet (NDS), 1995.

Table 7.-Harvest, sampling data, and coded wire tag recoveries for selected Upper Cook Inlet commercial coho salmon fisheries, 1995.

Fishery	Catch during sampling	Number of coho observed	Number of heads collected	1992 Release Sites		1993 Release Sites						1994 Release Sites				Tag not detected	Tag/Head lost	Total ^a decodable tags
				Cottonwood	Fish	L. Susitna	Ship	Bird	Cottonwood	Fish	Wasilla	L. Susitna	Ship	Campbell	Bird			
				Creek	Creek	River	Creek	Creek	Creek	Creek	River	Creek	Creek	Creek				
Central District																		
Driftnet	223,749	55,303	2,090	2	0	0	2	1	74	11	62	340	158	371	420	173	31	1,645
Eastside Setnet																		
Ninilchik	5,145	1,654	166	0	0	0	0	0	1	0	0	0	1	2	2	8	1	15
Cohoe	7,677	2,820	375	0	0	0	0	0	2	1	1	2	1	2	8	12	0	29
Kalifornski Beach	9,835	1,273	157	0	0	0	0	0	1	0	1	2	2	2	3	9	1	21
Salamatof	14,727	2,905	247	0	0	0	0	0	3	1	3	12	4	13	10	15	2	63
Eastside Beach Total	37,384	8,652	945	0	0	0	0	0	7	2	5	16	8	19	23	44	4	128
Central District Total	261,133	63,955	3,035	2	0	0	2	1	81	13	67	356	166	390	443	217	35	1,773
Northern District																		
Westside ^b	59,995	23,573	413	0	0	3	4	0	28	4	20	84	91	44	35	59	3	375
Susitna Flat/Pt. MacKenzie ^c	3,081	2,427	218	0	1	0	0	0	27	2	21	79	14	36	24	6	1	211
Fire Island	4,605	2,864	444	0	0	0	1	0	18	7	22	52	71	127	104	35	0	437
Eastside ^d	10,192	9,381	355	0	0	0	0	0	1	1	12	6	189	29	42	29	1	310
Northern District Total	77,873	38,245	1,430	0	1	3	5	0	74	14	75	221	365	236	205	129	5	1,333
Upper Cook Inlet Total	339,006	102,200	4,465	2	1	3	7	1	155	27	142	577	531	626	648	346	40	3,106

^a Total does not include heads collected with Kenai River or Crooked Creek coded wire tags.

^b Combination of statistical areas 247-10, 247-20, and 247-30.

^c Combination of statistical areas 247-41 and 247-42.

^d Combination of statistical areas 247-70, 247-80, and 247-90.

Table 8.-Estimated harvest (n) and standard error (SE) of coho salmon stocked in Northern Cook Inlet streams by sampled Upper Cook Inlet Central District commercial fisheries, 1995.

Stocked Into	Release Year	Central District Fishery										Setnet Total		Central District Total	
		Drift ^a		Eastside set net											
				Ninilchik		Cohoe		Kalifonski		Salamatof					
		n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE
Little Susitna River	1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1994	4,039	214	0	0	17	11	136	119	187	57	340	133	4,379	252
	Total	4,039	214	0	0	17	11	136	119	187	57	340	133	4,379	252
Ship Creek	1993	10	6	0	0	0	0	0	0	0	0	0	0	10	6
	1994	1,173	90	4	3	5	5	20	14	83	50	112	53	1,285	104
	Total	1,183	90	4	3	5	5	20	14	83	50	112	53	1,295	105
Bird Creek	1993	17	16	0	0	0	0	0	0	0	0	0	0	17	16
	1994	3,277	153	12	9	70	25	78	52	98	32	258	67	3,535	167
	Total	3,294	154	12	9	70	25	78	52	98	32	258	67	3,552	168
Campbell Creek	1994	3,077	154	14	10	9	6	24	17	146	39	193	44	3,270	160
Cottonwood Creek	1992	11	7	0	0	0	0	0	0	0	0	0	0	11	7
	1993	528	59	3	3	16	11	8	7	37	22	64	26	592	64
	Total	539	59	3	3	16	11	8	7	37	22	64	26	603	65
Fish Creek	1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1993	69	20	0	0	4	3	0	0	6	6	10	7	79	21
	Total	69	20	0	0	4	3	0	0	6	6	10	7	79	21
Wasilla Creek	1993	475	58	0	0	5	4	8	7	72	50	85	51	560	77
Total	1992	11	7	0	0	0	0	0	0	0	0	0	0	11	7
	1993	1,099	87	3	3	25	13	16	10	115	55	159	57	1,258	104
	1994	11,566	318	30	14	101	28	258	132	514	91	903	164	12,469	357
	Total	12,676	329	33	14	126	31	274	132	629	107	1,062	173	13,738	372

^a Includes statistical areas 244-50, 244-60, 245-70, 245-80, 245-90.

Table 9.-Estimated harvest (n) and standard error (SE) of coho salmon stocked in Northern Cook Inlet streams by sampled Upper Cook Inlet Northern District commercial fisheries, 1995.

Stocked Into	Release Year	Northern District Fishery								Northern District Total	
		West Side ^a		Su. Flat/Pt. MacKenzie ^b		Fire Island		East Side ^c		n	SE
		n	SE	n	SE	n	SE	n	SE		
Little Susitna River	1993	121	71	0	0	0	0	0	0	121	71
	1994	565	63	369	39	331	53	67	35	1,332	97
	Total	686	95	369	39	331	53	67	35	1,453	120
Ship Creek	1993	9	3	0	0	2	2	0	0	11	4
	1994	315	30	137	55	565	86	332	17	1,349	108
	Total	324	30	137	55	567	86	332	17	1,360	108
Bird Creek	1993	0	0	0	0	0	0	0	0	0	0
	1994	153	25	62	10	371	34	246	46	832	63
	Total	153	25	62	10	371	34	246	46	832	63
Campbell Creek	1994	209	31	116	17	493	50	232	52	1,050	80
Cottonwood Creek	1992	0	0	0	0	0	0	0	0	0	0
	1993	87	15	81	14	101	36	2	1	271	41
	Total	87	15	81	14	101	36	2	1	271	41
Fish Creek	1992	0	0	3	2	0	0	0	0	3	2
	1993	15	8	5	2	20	7	2	1	42	11
	Total	15	8	8	3	20	7	2	1	45	11
Wasilla Creek	1993	65	13	92	35	100	26	24	5	281	46
Total	1992	0	0	3	2	0	0	0	0	3	2
	1993	297	74	178	38	223	45	28	5	726	95
	1994	1,242	80	684	71	1,760	117	877	79	4,563	177
	Total	1,539	109	865	81	1,983	126	905	79	5,292	201

^a Includes statistical areas 247-10, 247-20, and 247-30.

^b Includes statistical areas 247-41 and 247-42.

^c Includes statistical areas 247-70, 247-80, and 247-90.

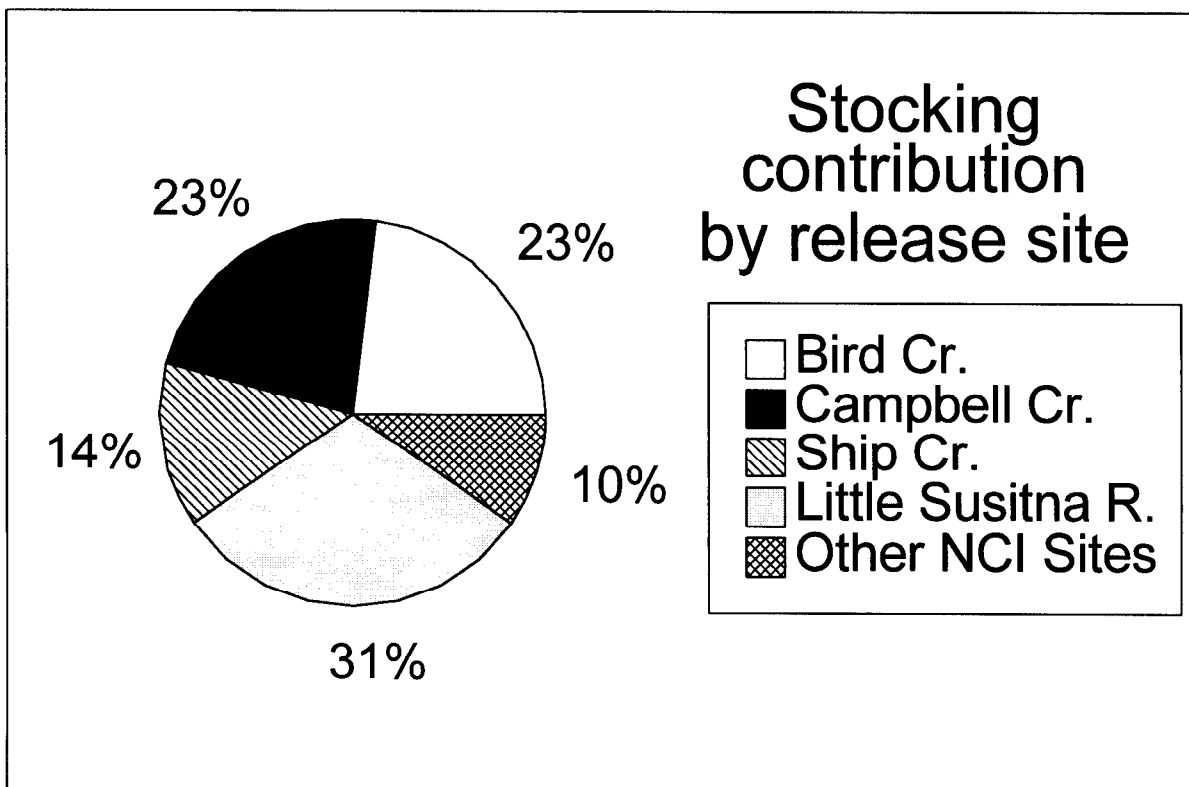
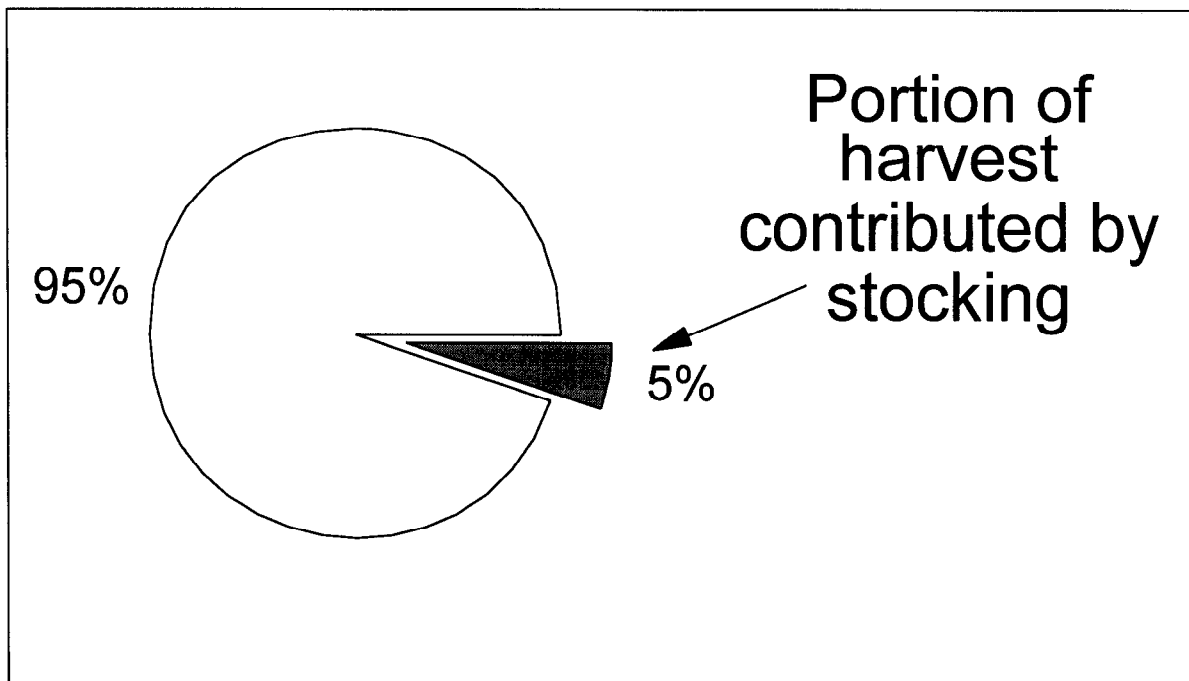


Figure 4.-Portion of 1995 Upper Cook Inlet coho salmon commercial harvest represented by urban stocked fish.

Table 10.-Estimated harvest (n) and standard error (SE) of Northern Cook Inlet hatchery produced coho salmon by release year in sampled commercial fisheries, 1995.

Sampled Fishery	Statistical Area	Coho catch	1992 Releases			1993 Releases			1994 Releases			Total		
			n	SE	percent	n	SE	percent	n	SE	percent	n	SE	percent
Central District Drift^a	244, 245	234,126	11	7	0.0%	1,099	87	0.5%	11,566	318	4.9%	12,676	329	5.4%
Central District Set														
Niniichik	244-21	6,376	0	0	0.0%	3	3	0.0%	30	14	0.5%	33	14	0.5%
Cohoe	244-22	8,618	0	0	0.0%	25	13	0.3%	101	28	1.2%	126	31	1.5%
Kalifornski	244-30	12,142	0	0	0.0%	16	10	0.1%	258	132	2.1%	274	132	2.3%
Salamatof	244-40	17,614	0	0	0.0%	115	55	0.7%	514	91	2.9%	629	107	3.6%
Eastside setnet total		44,750	0	0	0.0%	159	57	0.4%	903	164	2.0%	1,062	173	2.4%
Northern District Set^b														
Westside	247-10,20,30	65,055	0	0	0.0%	297	74	0.5%	1,242	80	1.9%	1,539	109	2.4%
Susitna Flats/Pt. MacKenzie	247-41,42	4,246	3	2	0.1%	178	38	4.2%	684	71	16.1%	865	81	20.4%
Fire Island	247-43	6,012	0	0	0.0%	223	45	3.7%	1,760	117	29.3%	1,983	126	33.0%
Eastern	247-70/80/90	11,988	0	0	0.0%	28	5	0.2%	877	79	7.3%	905	79	7.5%
Northern setnet total		87,301	3	2	0.0%	726	95	0.8%	4,563	177	5.2%	5,292	201	6.1%
Sampled Upper Cook Inlet fisheries total		366,177	14	7	0.0%	1,984	140	0.5%	17,032	399	4.7%	19,030	423	5.2%

^a Excluding Chinitna Bay substat area.

^b Excluding Knik Arm substat area.

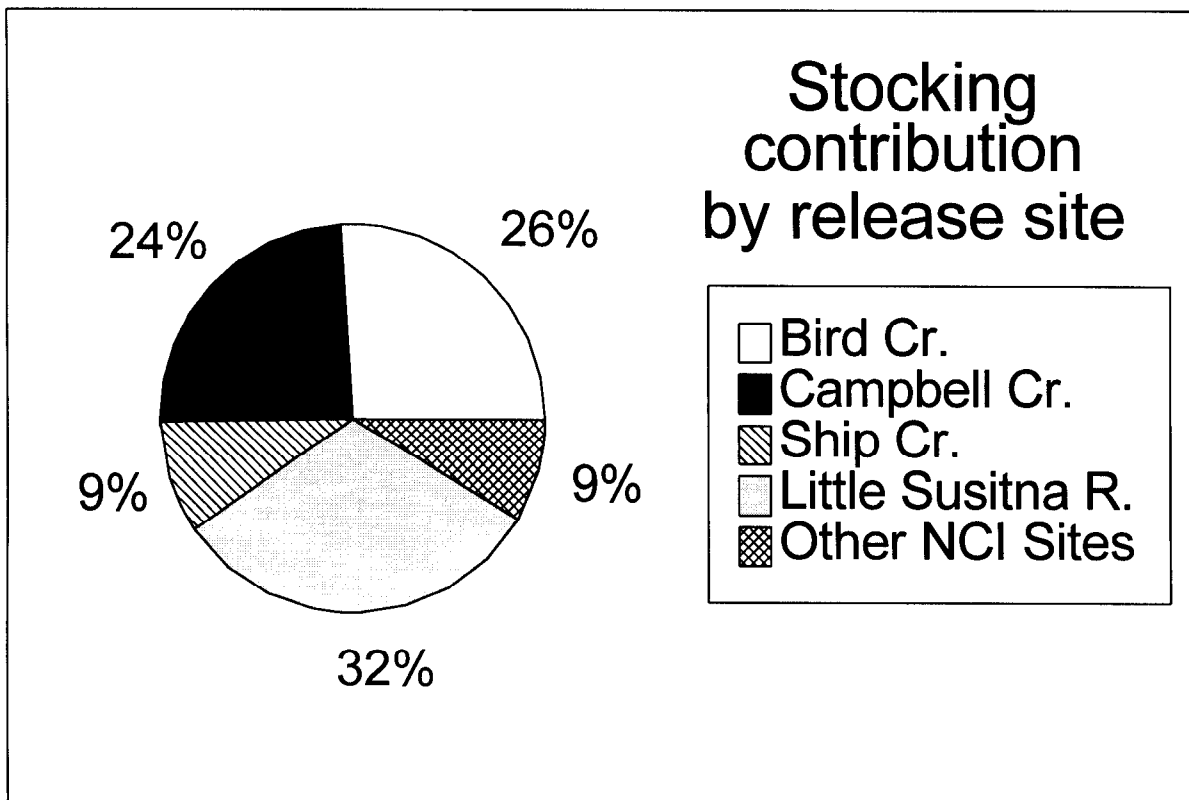
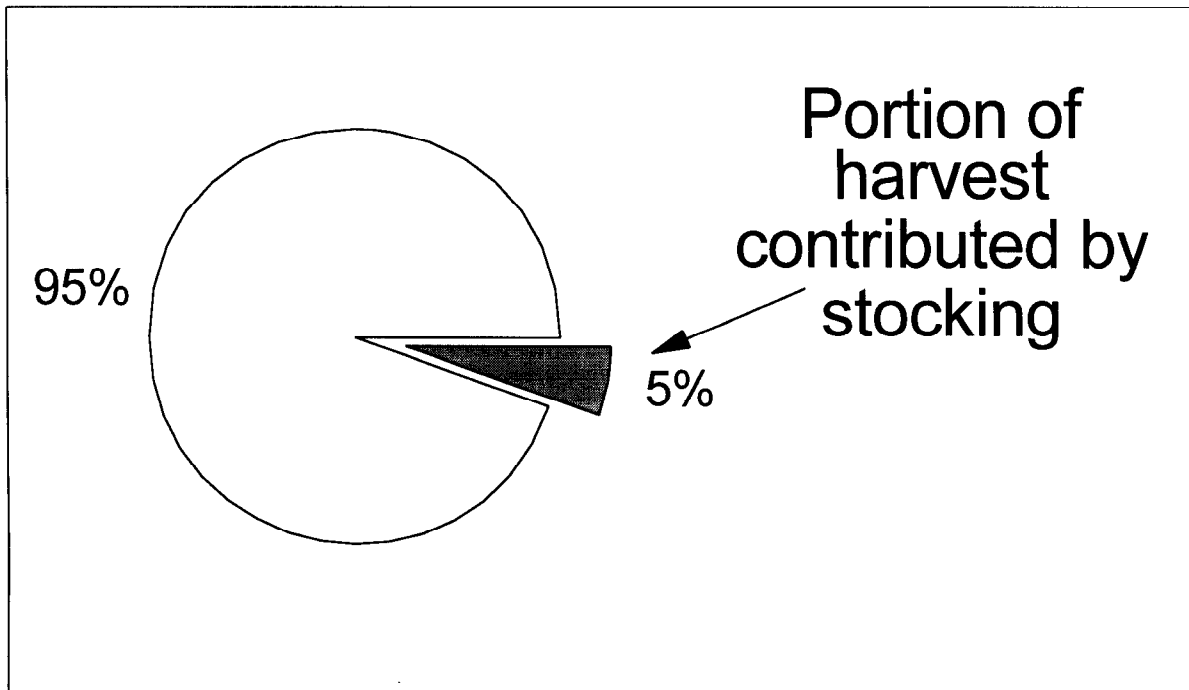


Figure 5.-Portion of 1995 Central District drift net coho salmon commercial harvest represented by urban stocked fish.

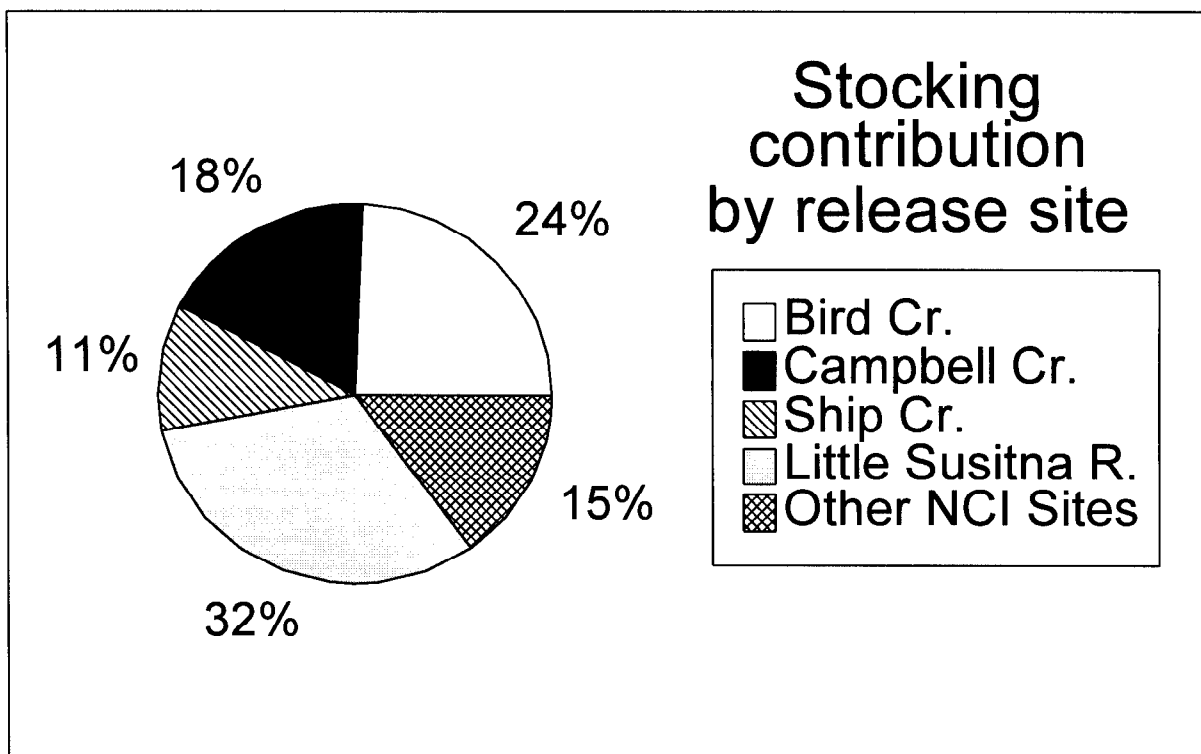
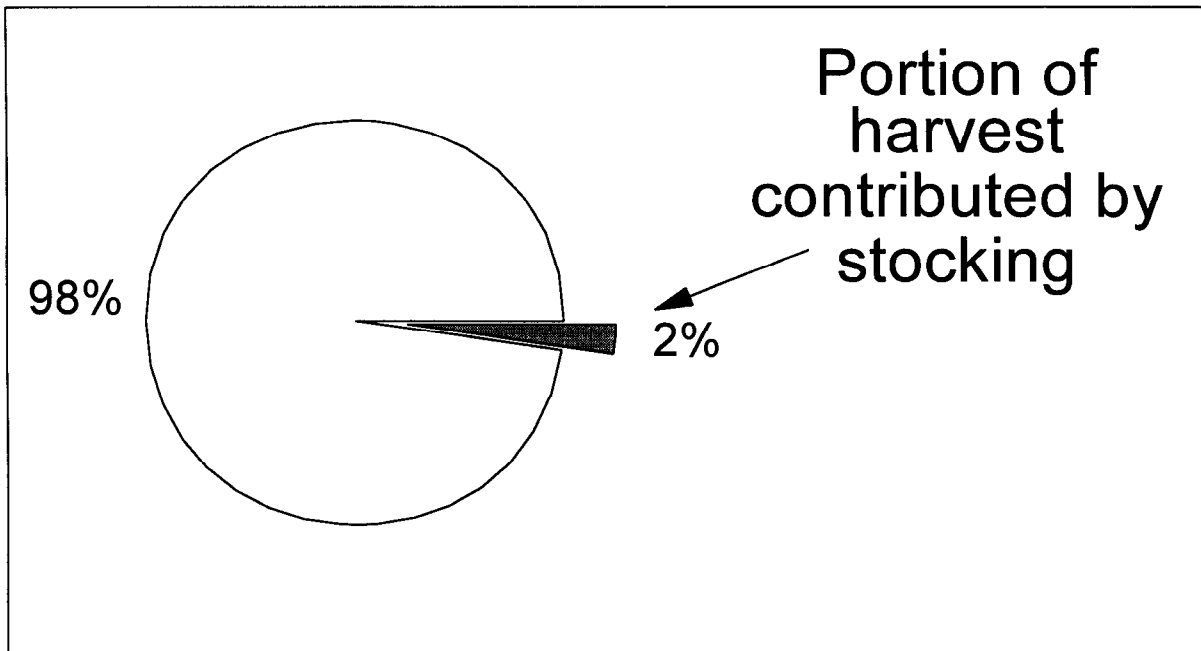


Figure 6.-Portion of 1995 Central District, Upper Subdistrict setnet coho salmon commercial harvest represented by urban stocked fish.

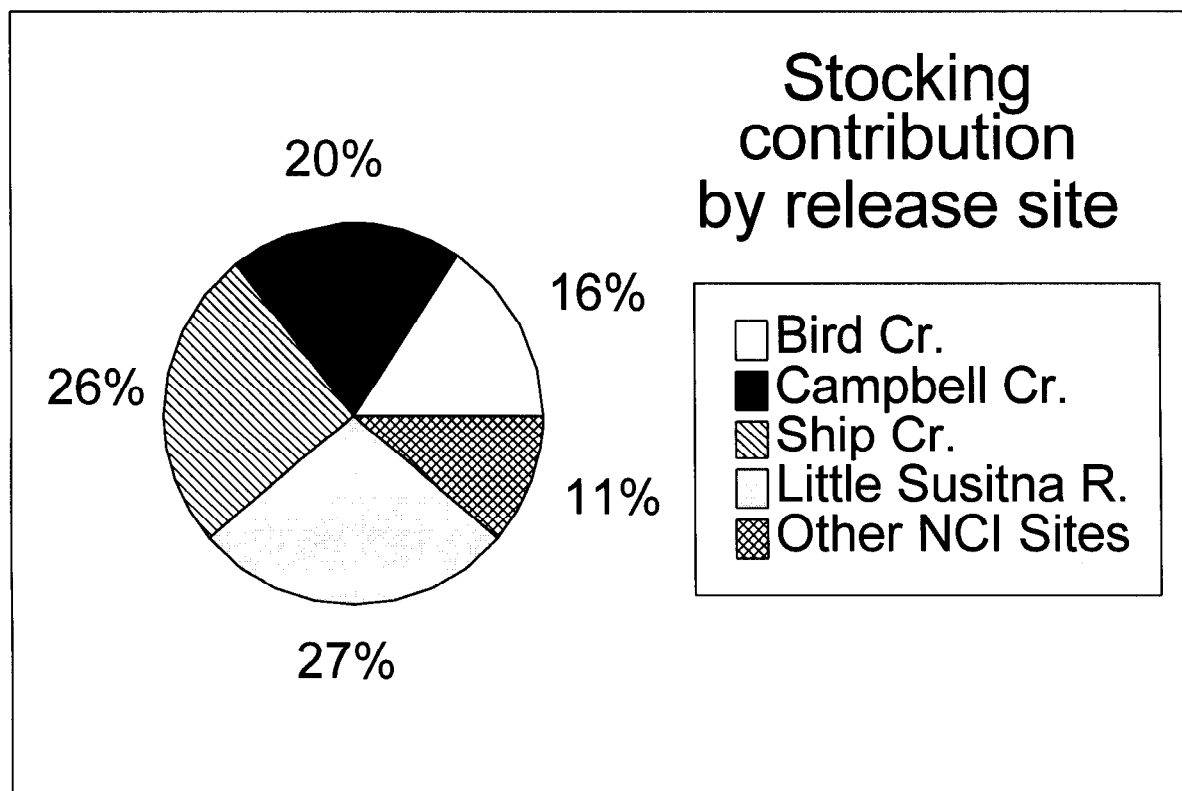
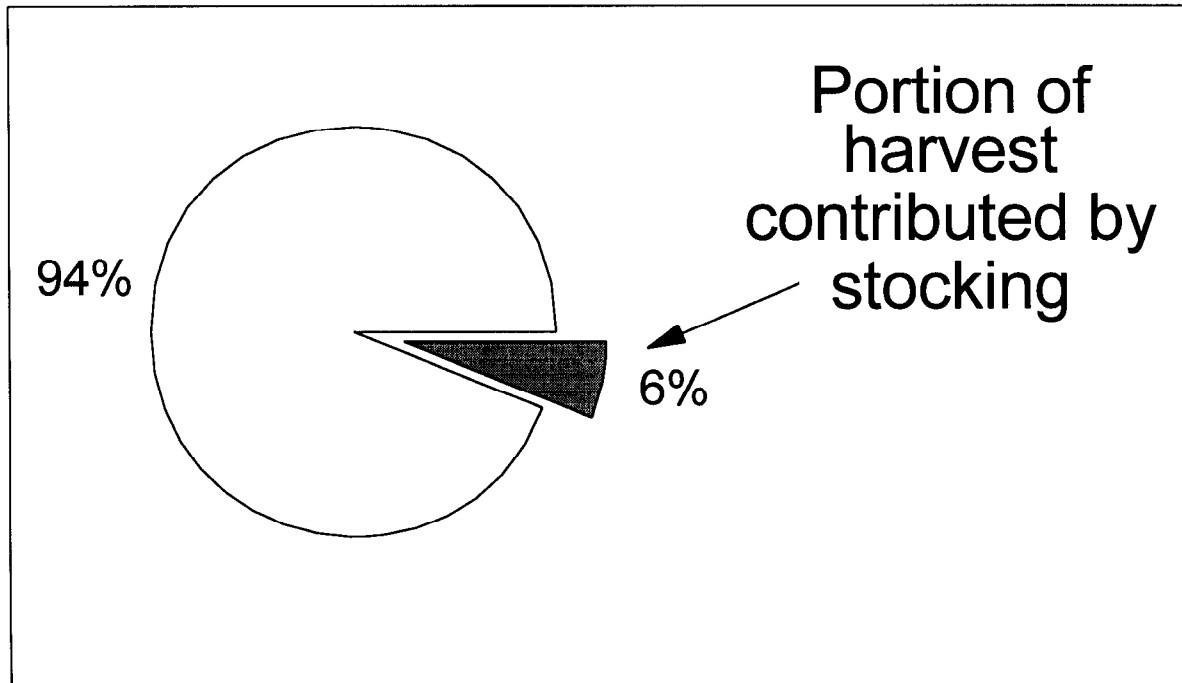


Figure 7.-Portion of 1995 Northern District setnet coho salmon commercial harvest represented by urban stocked fish.

Table 11.-Estimated harvest (n) and standard error (SE) of coho salmon stocked in Northern Cook Inlet streams by sampled Upper Cook Inlet commercial fisheries, 1995.

Stocked Into	Release Year	Central District ^a		East Side ^b		Northern District ^c		Total	
		Drift		Set Net		Set Net			
		n	SE	n	SE	n	SE	n	SE
Little Susitna River	1993	0	0	0	0	121	71	121	71
	1994	4,039	214	340	133	1,332	97	5,711	270
	Total	4,039	214	340	133	1,453	120	5,832	279
Ship Creek	1993	10	6	0	0	11	4	21	7
	1994	1,173	90	112	53	1,349	108	2,634	150
	Total	1,183	90	112	53	1,360	108	2,655	150
Bird Creek	1993	17	16	0	0	0	0	17	16
	1994	3,277	153	258	67	832	63	4,367	179
	Total	3,294	154	258	67	832	63	4,384	179
Campbell Creek	1994	3,077	154	193	44	1,050	80	4,320	179
Cottonwood Creek	1992	11	7	0	0	0	0	11	7
	1993	528	59	64	26	271	41	863	76
	Total	539	59	64	26	271	41	874	77
Fish Creek	1992	0	0	0	0	3	2	3	2
	1993	69	20	10	7	42	11	121	23
	Total	69	20	10	7	45	11	124	23
Wasilla Creek	1993	475	58	85	51	281	46	841	89
Total	1992	11	7	0	0	3	2	14	7
	1993	1,099	87	159	57	726	95	1,984	140
	1994	11,566	318	903	164	4,563	177	17,032	399
	Total	12,676	329	1,062	173	5,292	201	19,030	423

^a Includes statistical areas 244-50, 244-60, 245-70, 245-80, and 245-90.

^b Includes statistical areas 244-21, 244-22, 244-30, and 244-40.

^c Includes 247-10, 247-20, 247-30, 247-41, 247-42, 247-43, 247-70, 247-80, and 247-90.

An estimated 340 (6%) Little Susitna River hatchery coho salmon from 1994 releases were harvested in the Central District eastside setnet fishery; about 90% of these fish were harvested from 17 July to 31 July. The Northern District setnet fishermen harvested 1,332 (23%) Little Susitna River hatchery coho salmon from 1994 releases; about 69% were taken from 21 July to 4 August.

The majority of returning adult coho salmon stocked into Bird Creek in 1994 were harvested in sampled 1995 UCI commercial fisheries taken by the Central District drift fleet (3,277, 75%, Appendices C12-C20). Over 80% of these fish were harvested from 17 July to 31 July. An estimated 258 (6%) Bird Creek hatchery coho salmon were harvested in the Central District

Eastside setnet fishery, about 65% of these fish were harvested from 21 July to 28 July. The Northern District setnet fishery harvested 832 (19%) Bird Creek stocked coho salmon, approximately 70% were harvested from 21 July to 7 August.

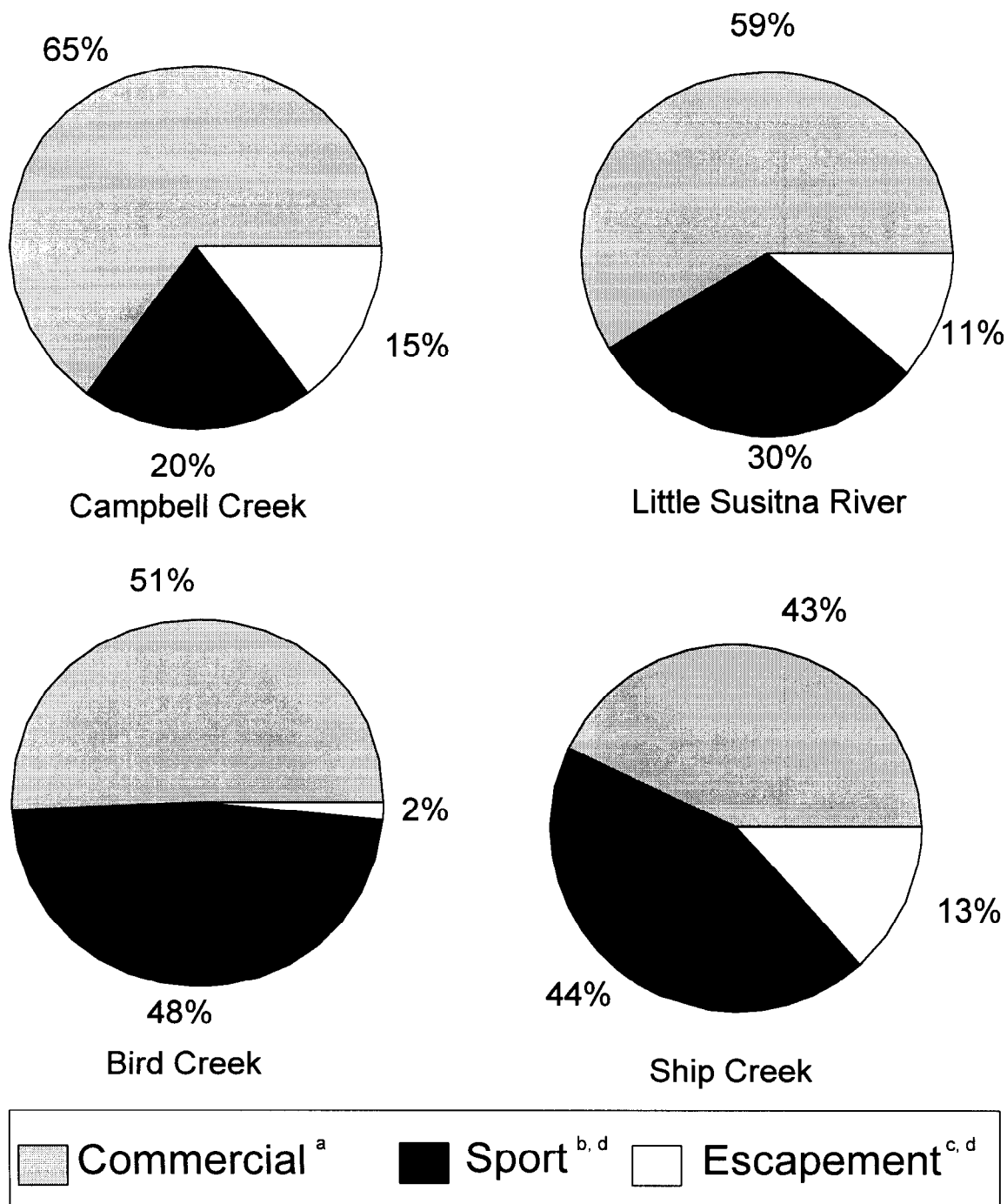
The Central District drift fleet harvested most of the adult coho salmon stocked into Campbell Creek in 1994 that were sampled in the 1995 UCI commercial fisheries (3,077, 71%; Appendices C12-C20). Over 75% of these fish were harvested from 17 July to 31 July. An estimated 193 (5%) Campbell Creek hatchery coho salmon from 1994 releases were harvested by the Central District eastside setnet fishery, 67% of these fish were harvested from 25 July to 14 August. The Northern District setnet fishery harvested 1,050 (24%) Campbell Creek hatchery coho salmon from 1994 releases; approximately 71% of these fish were harvested from 21 July to 7 August.

Ship Creek brood stock in 1994 stockings had a later run timing than brood stocks used in 1994 stockings of Little Susitna River, and Bird and Campbell creeks. This resulted in a slight delay in the peak harvest by the Central District drift fleet of coho salmon stocked into Ship Creek compared to the aforementioned release cohorts (Appendices C12-C20). About 45% (1,173) returning adult coho salmon stocked into Ship Creek in 1994 were harvested in sampled 1995 UCI commercial fisheries by the Central District drift fleet, about 68% of these fish were harvested from 17 July to 4 August. An estimated 112 (4%) Ship Creek hatchery coho salmon from 1994 releases were harvested by the Central District Eastside setnet fishery, 75% were harvested from 24 July to 14 August. Peak harvest by the Northern District setnet fishery of coho salmon stocked into Ship Creek was approximately 2 weeks later than harvests of other release cohorts by the Northern District setnet fishery. The Northern District setnet fishery harvested an estimated 1,349 (51%) Ship Creek hatchery coho salmon; approximately 78% were harvested from 14 August to 1 September. Relatively few (< 1,800) coho salmon stocked into Cottonwood, Fish, and Wasilla creeks in 1992 and 1993 were harvested in the 1995 UCI sampled commercial fisheries. The majority of these fish were harvested in the Central District drift fleet and Northern District setnet fisheries.

RETURNS

Total returns of coho salmon to urban area streams are made up of three measurable components: spawning escapement, commercial harvest, and inriver sport harvest. The spawning escapement and estimates of commercial harvest are presented in this report. Total inriver sport harvest was estimated by SWHS (Howe et al. 1996). Approximately 43% of Ship Creek hatchery returns, 51% of Bird Creek hatchery returns, 65% of Campbell Creek hatchery returns, and 59% of Little Susitna River hatchery returns were harvested by the commercial fishery (Figure 8).

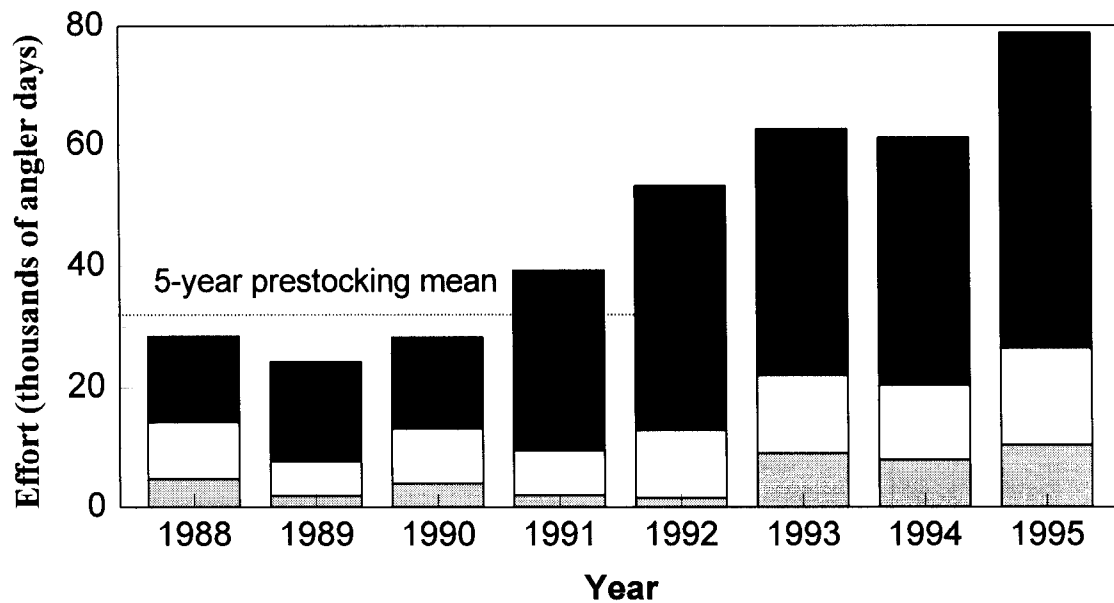
Inseason observations of the sport fishery at the Anchorage urban streams indicated that the coho salmon stocking program met expectations. Sport harvest, catch, and effort estimates for 1995 increased in Ship and Campbell creeks compared to 1994 (Figure 9). Sport harvest and catch were lower in Bird Creek, however, effort did increase when compared to 1994. Differences in sport harvest, catch, and effort were most likely due to the number of coho salmon smolt stocked in 1994. Total effort again exceeded 61,000 angler-days compared to the 5-year prestocking annual average of 34,700 angler-days. A total of nearly 79,000 angler-days of effort were expended in 1995. A total harvest and catch of 9,328 and 16,069 coho salmon, respectively, also occurred.



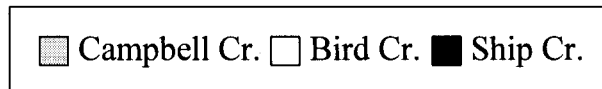
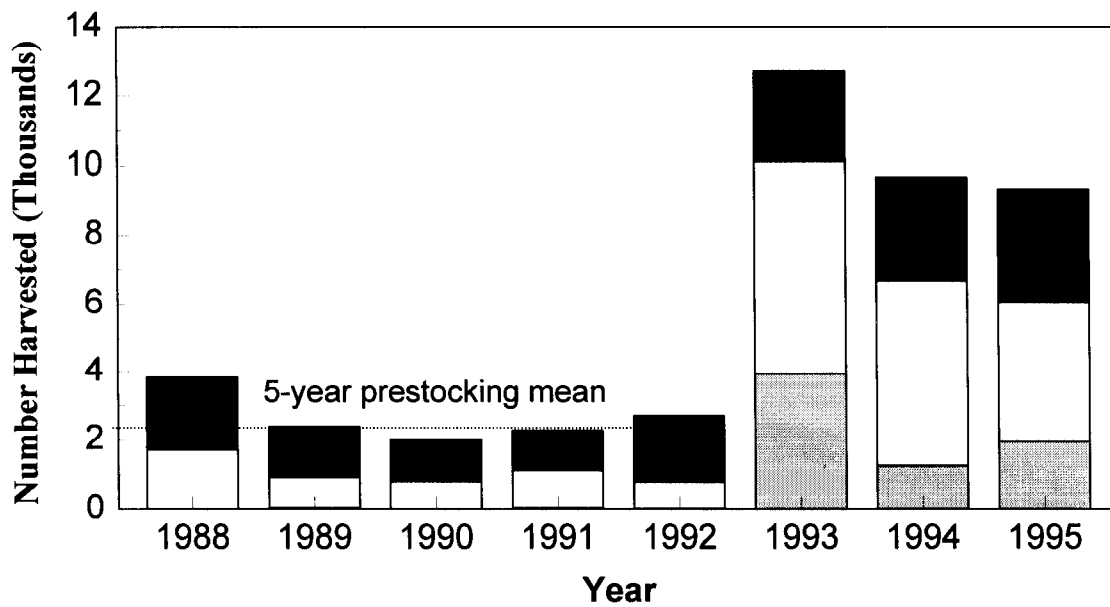
- ^a Estimate of hatchery contribution to the UCI coho salmon commercial harvest from catch sampling data.
- ^b Estimate of sport harvest of coho salmon from SVHS (estimates of hatchery contribution not calculated).
- ^c Estimate of hatchery contribution to the escapement (Bird Creek is a minimum estimate of the total escapement from a foot survey).
- ^d Estimates of hatchery contribution to Little Susitna River sport harvest and escapement from Bartlett (1996b).

Figure 8.-Distribution of coho salmon total returns among commercial and sport fisheries and the escapement in four stocked streams.

Fishing Effort



Coho Salmon Harvest



Source: Mills 1989-1994, Howe et al. 1995, 1996

Figure 9.-Sport harvest and effort from 1988 to 1995 in Anchorage urban streams stocked with coho salmon.

MARINE SURVIVAL

Overall marine survival of the four major coho salmon cohorts released in 1994 and recovered in 1995 was 0.083 (SE =0.003; Table 12). Survival estimates ranged from 0.076 for smolt releases into Little Susitna River to 0.102 for smolt released into Bird Creek. Estimated survival for smolt released at Ship Creek was 0.081. Estimates of the total run, and thus survival, of stocked coho salmon at Bird creek is biased somewhat high because sport harvest was assumed to be solely stocked coho salmon.

DISCUSSION

SPORT FISHERY

The measure of success of the coho salmon stocking program is an increase in angler effort and harvest (Stratton et al. 1995). The prestocking 5-year mean (1988-1992) effort total in Ship, Campbell, and Bird creeks was 34,699 angler days of effort. The prestocking 5-year mean harvest total for Ship, Campbell, and Bird creeks was 2,516 coho salmon. The targeted increase in harvest of 10,000 fish was not achieved in 1995 primarily due to smaller numbers of smolt stocked into these systems in 1994. Harvest increased by 6,812 coho salmon in 1995 relative to the prestocking 5-year mean. The estimated harvest is species specific so this increase is easily quantified. The ultimate measure of success, however, is increased angler effort. Statewide Harvest Survey estimates angling effort for all species combined. Increased angler effort for a specific species is not easily quantified and may be masked or exaggerated by fluctuations in effort of other fisheries. The targeted increase in angler effort of 25,000 angler-days was achieved with an increase of 44,153 angler-days effort over the prestocking 5-year mean effort, and an increase of 25,472 angler-days effort over effort in 1992, the last year before stocked fish returned. The true increase in angler effort for coho salmon may be masked by the continually increasing popularity of the chinook salmon fishery in Ship Creek. This fishery has grown dramatically in recent years and is included in the estimate of angler effort. In addition, a weakness of using the SWHS is that the survey targets licensed anglers. Urban streams, especially Campbell Creek, are fished primarily by young anglers who are not required to purchase a license (from field observations in 1993-1995). Thus, these estimates of harvest and effort are considered minimal estimates. Many coho salmon caught in stocked urban creeks after the peak of the run are not retained. A substantial increase in the catch of coho salmon has occurred in Ship, Campbell, and Bird creeks since the start of the stocking program. The prestocking 3-year (SWHS did not estimate catch until 1990) mean catch for Ship, Campbell, and Bird creeks is 3,077 coho salmon. Catch increased by 12,992 coho salmon in 1995 relative to the prestocking 3-year mean. We believe results presented in this report and field observations of the sport fisheries indicate that the urban coho salmon stocking program exceeded all expectations in 1995.

In 1995 coho salmon were available in the entire Campbell Creek drainage by the sport fishery opening date on 25 July. Angler effort was primarily concentrated in the lower areas of the creek from C Street downstream to Dimond Boulevard in July and August. By late August and September most angler effort occurred from C Street upstream to Folker Street. As in 1994 many of the fish stayed in Campbell Lake, which is closed to all sport fishing, until sexually mature and did not migrate upstream until late August and early September. Of the estimated

Table 12.-Estimated marine survival of coho salmon stocked into four Northern Cook Inlet streams, 1995.

	1994 Smolt Releases		1995 Commercial Harvest of 1994 Releases		1995 Sport Harvest of 1994 Releases		1995 Escapement of 1994 Releases		Estimated Total Hatchery Run of 1994 Releases		Estimated Smolt Survival	
	n	SE	n	SE	n	SE	n	SE	n	SE		SE
Bird Creek	84,643	1,184 ^a	4,367	179	4,121 ^b	662 ^e	139 ^g		8,627	685 ^h	0.102	0.008 ⁱ
Campbell Creek	87,686	1,012 ^a	4,320	179	1,348 ^b	228 ^e	985 ^g		6,653	290 ^h	0.076	0.003 ⁱ
Ship Creek	75,779	2,159 ^a	2,634	150	2,704 ^c	583 ^e	826	31	6,164	603 ^h	0.081	0.008
Little Susitna River	126,694	1,002 ^a	5,711	270	2,905 ^d	391 ^{e,f}	1,135	137	9,751	495 ^h	0.077	0.004
Total	374,802	2,845	17,032	399	11,078	991	3,085	140	31,195	1,078 ^h	0.083	0.003 ⁱ

^a Smolt releases and their SE's as reported by Starkey and Hansen (1995).

^b Total estimated harvest as reported in Howe et al. (1996). The predominant contribution to the harvest is from 1994 releases, though contributions from previous release years are assumed to be included. Additionally, a component of this harvest is composed of nonhatchery fish.

^c Contribution of 1994 releases calculated using proportion of 1994 releases to Ship Creek weir, applied to the harvest estimate reported by Howe et al. (1996).

^d Contribution of 1994 releases to sport harvest calculated by multiplying relative contribution estimate from Bartlett (1996b) with the total harvest estimate reported by Howe et al. (1996).

^e Standard errors of total 1995 mail-survey harvest estimates approximated using coefficients of variation for the 1994 harvest survey estimates.

^f Standard error of 1994 releases to 1995 sport harvest calculated using Goodman's (1960) formula utilizing the sampling error reported by Bartlett (1996b) along with the approximated total harvest variance.

^g Escapement index from foot surveys - representing a minimal estimate of the total escapement. No estimate of sampling variability available.

^h Estimated total hatchery run of 1994 releases does not include any remaining adult coho salmon that are expected to return in low numbers in 1996.

ⁱ SE's of survival estimates assumed to be biased (too low) due to no estimates of sampling variance for estimated escapement.

4,910 coho salmon caught by anglers at Campbell Creek in 1995 (Howe et al. 1996), over 60% (approximately 2,950) were released. Conversely, the fisheries in Bird and Ship creeks, being essentially intertidal, were more closely related to the tides. Greatest success was during the low tide, although during the peak of the return, fish were available at all tide stages. Approximately 34% of the coho salmon caught in these two creeks were released and angler effort in 1995 was about 14,500 angler-days greater than that in 1994.

ESCAPEMENT

The Ship Creek biological escapement goal (BEG) of 200 coho salmon was exceeded on 24 August with an escapement count of 260 fish at the Ship Creek weir. An emergency order was issued (effective 25 August) that increased the daily bag and possession limit of sport-caught coho salmon from three fish per day to five fish per day.

The Campbell Creek BEG of 200 coho salmon was exceeded on 6 September when a preliminary foot survey conducted on Campbell Creek upstream of Lake Otis indicated that about 800 coho salmon had escaped the sport fishery. As a result of the survey, an emergency order was issued (effective 11 September) that increased the daily bag and possession limit of sport caught coho salmon from three fish per day to five fish per day and extended the open season from 15 October to 31 December 1995. The final escapement count conducted on 11-12 October at Campbell Creek of 1,423 coho salmon was over seven times greater than the BEG indicating that returns from this stocking effort were more than adequate for supporting the fishery. Coho salmon stocking will be reduced from 150,000 smolt to 75,000 smolt in 1996.

A foot survey conducted on 9 October on Bird Creek and Penguin Creek (a tributary of Bird Creek) tallied 139 coho salmon. Five aerial surveys were flown over selected Turnagain Arm rivers and streams from 15 August to 2 November. Run timing of native coho salmon stocks in Turnagain Arm is generally 3-6 weeks later than streams stocked with Little Susitna brood stock. Peak counts from aerial surveys were observed in Twentymile and Placer river drainages around 12 October with a total of 987 and 810 coho salmon observed, respectively. Peak counts from aerial surveys in selected Portage Creek tributaries were observed around 20 October with a total of 307 coho salmon observed (Appendix B3). Heavy rains and flooding in late September delayed foot surveys of creeks in the Anchorage bowl and resulted in channel changes to some of the Turnagain Arm systems. Estimated escapement counts were smaller in Campbell and Bird creeks compared to escapement counts conducted in 1994. Coho salmon escapement counts conducted in Portage Creek drainage and Ship Creek in 1995 were greater than those conducted in 1994. There were no significant differences in coho salmon escapement counts conducted in Twentymile and Placer river drainages in 1995 compared to those conducted in 1994.

STRAYING

The straying of hatchery-reared coho salmon was tested because of concerns that hatchery fish may compete with wild stocks for spawning areas. Our results indicate that straying is not a major concern. Minimal straying occurred in Ship Creek (0.7%) and at Little Susitna River (1.3%). One coho salmon of Kenai River origin showed up at the Little Susitna weir and one coho salmon with a Campbell Creek CWT was discovered in fish sampled from Ship Creek weir.

TAG LOSS

Tag loss was detected by the absence of coded wire tags in fish missing the adipose fin. Both wild stock and hatchery-reared coho salmon can have naturally missing adipose fins, < 0.15%

(Blankenship 1990). This small percentage of possible naturally missing adipose fins in wild and hatchery-reared coho salmon indicate that the vast majority of coho salmon missing the adipose fin are coded wire tagged fish. Tag loss estimated from escapement samples ranged from 5% to 6% while tag loss in these same groups ranged between 1%-5% at release (Starkey et al. 1995). Therefore, tag loss of most release cohorts was relatively low after release. Grading smolt into size classes and using different head mold sizes when tagging fish to improve tag placement has likely improved tag retention of smolt releases since 1993.

COMMERCIAL CATCH ASSESSMENT

Catch sampling of the UCI coho salmon fishery in 1995 was conducted when 93% of the coho salmon harvest occurred. Technicians examined 28% of the total harvest for sampled UCI fisheries and over 4% of the fish examined had a missing adipose fin. In the Northern District, 44% of the coho salmon harvested were examined for a missing adipose fin. In the Central District, 24% were sampled in the driftnet and 19% were examined in the eastside setnet fisheries. It was possible to sample a greater proportion of the Northern District harvest than the Central District harvest because fewer processors purchased fish, there were fewer fishing periods, and all fishing periods were scheduled openings rather than a combination of scheduled and emergency order openings.

The sampling effort of the commercial harvest provided relatively precise estimates. Relative precision of the total harvest of hatchery-produced fish by the UCI commercial fisheries was 4%. Estimates were most precise for the Central District driftnet (5%) and the Northern District setnet fisheries (7%), and much less precise for the Central District eastside setnet fishery (32%). The estimated harvest by the eastside setnet fishery was not as precise because a lower proportion of the harvest was sampled and because fewer tags were recovered from this fishery.

Harvest estimates of coho salmon stocked into Bird, Campbell, and Ship creeks had good precision (relative precision < 12%) because: (1) over 50% of the smolt in each release group were tagged, and (2) a large sample from the commercial harvest was obtained. Estimates of harvest of fish stocked into Little Susitna River were also relatively precise (9%). Harvest estimates of coho salmon stocked into Cottonwood, Fish, and Wasilla creeks were less precise (17%-37%), then other stocked cohorts because relatively few of these tagged fish were observed in the sampled commercial harvests. Based on estimates of commercial harvest (1,839) and sport harvest (1,220; Howe et al. 1996) of coho salmon, it appears returns from stocking efforts into Cottonwood, Fish, and Wasilla creeks may have been low. Peltz and Starkey (1993) correctly hypothesized that smolt stocked into these systems in 1993 would hold over in fresh water an additional year after release and have poor marine survival because of their small size and poor health.

The commercial coho salmon harvest pattern was typical of previous years. Of the total coho salmon harvested in the sampled UCI sampled fisheries, 64% were taken in the Central District driftnet fishery, 12% were harvested in the Central District eastside setnet fishery, and 24% were harvested in the Northern District setnet fishery. The majority of hatchery stocked fish harvested in sampled UCI commercial fisheries were taken in the Central District driftnet fishery: 66% of the total commercial harvest of coho salmon stocked into Anchorage urban systems (Bird, Campbell, and Ship creeks combined) and 69% of the total commercial harvest of coho salmon stocked into Little Susitna River. The Northern District setnet fishery took 29% of the estimated

total commercial harvest of coho salmon stocked into Anchorage urban systems and 25% of the estimated total commercial harvest of coho salmon stocked into Little Susitna River. Fish stocked into Bird, Campbell, and Ship creeks were primarily harvested along both the west (247-10,20,30) and east (247-70,80,90) sides of the Northern District and around Fire Island (247-43) near Anchorage. Fish stocked into Cottonwood, Fish, and Wasilla creeks were harvested primarily along the west side of the Northern District, around Point MacKenzie (247-42), and around Fire Island (247-43). Coho salmon stocked into Little Susitna River were harvested primarily along the west (247-10,20,30) side of the Northern District and around both Fire Island (247-43) and Point MacKenzie (247-42). The Central District eastside setnet fishery took only 5% of the total commercial harvest of coho salmon stocked into the Anchorage urban systems and 6% of the coho salmon stocked into Little Susitna River, with most of the harvest occurring in the statistical areas 244-30 and 244-40 which are nearest the Northern District.

Pooling data among statistical areas generally did not improve precision of the estimates of the Central District eastside setnet fisheries. Estimates of harvest of all marked cohorts observed within the statistical area/day strata are not independent. The total variance estimate calculated in previous reports (Hoffmann and Hasbrouck 1994, Stratton et al. 1996) had an additional covariance component (Clark and Bernard 1987, Bernard and Clark *In press*). The small reduction in total variance resulting from incorporation of the covariance terms occurred because the catch sampling program recovers a large number of tagged fish from each cohort and the Tag Lab loses few heads due to good quality control. In previous years, incorporation of covariance terms resulted in insignificant differences in total variance estimates. As such, covariance terms were not used in 1995 calculations, and therefore estimates of total variance are biased somewhat high.

Our results justify continuation of the stocking program. Additional streams flowing into Knik and Turnagain Arms may be stocked depending on availability of brood stock. Wild stock coho salmon from the Susitna River drainage will be marked and coded wire tagged in future years. The terminal and commercial assessment programs should continue to evaluate the stocking program and determine if the success of the stocking program continues. Recommendations for the future include increasing sampling of several statistical areas in the Northern District (i.e., 247-10, 247-20, 247-30, 247-50, 247-70, 247-80, and 247-90) to obtain samples specific to each statistical area. This could be accomplished by placing technicians on-board tenders more frequently, closely following buying patterns of processors inseason, maintaining good rapport with processors, and stationing technicians in Homer and Soldotna. These steps would improve our ability to sample pure loads of coho salmon harvested in these statistical areas.

ACKNOWLEDGMENTS

The data presented here result from the efforts of many individuals. Mike Seine, Don Perrin, Brad Fisher, and Doug Lieb conducted commercial catch sampling in Anchorage, operated the Ship Creek weir, and assisted with escapement foot surveys of Anchorage area streams. Don Perrin and Mike Seine collected sport angler use data on selected Turnagain Arm streams, conducted limited regulation enforcement, and assisted in coho salmon brood stock sampling in Campbell and Explorer creeks. Dave Waltemyer, Kim Rudge, and Jay Carlon supervised a host of technicians from the Soldotna ADF&G office who collected data from the Central District. Anna Sharp, Sam Bertoni, Karen Crandall, and the rest of the staff at the Tag Lab in Juneau were

always helpful and patient in helping us deal with coded wire tag data. The U.S. Forest Service (USFS) Glacier Ranger District cooperated with ADF&G field technicians in Turnagain Arm and shared coho salmon escapement data from foot surveys conducted by USFS on Turnagain Arm streams.

LITERATURE CITED

- ADF&G (Alaska Department of Fish and Game). 1996. Run forecasts and harvest projections for 1996 Alaska salmon fisheries and review of the 1995 season. (The short version.) In H. J. Geiger and B. Frenette, editors, Commercial Fisheries Management and Development Division, Regional Information Report No. 5J95-05, Juneau.
- Bartlett, L. D. 1996a. Escapement, and stock statistics for coho salmon on the Little Susitna River and selected Matanuska-Susitna Valley, Alaska streams during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 96-16, Anchorage.
- Bartlett, L. D. 1996b. Escapement, and stock statistics for coho salmon of the Little Susitna River and selected streams of the Matanuska-Susitna Valley, Alaska, 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-39, Anchorage.
- Bernard, D. R. and J. E. Clark. *In press*. Estimating salmon harvest based on return of coded-wire tags. Canadian Journal of Fisheries and Aquatic Sciences.
- Blankenship, H. L. 1990. Effects of time and fish size on coded wire tag loss from chinook and coho salmon. Pages 237-243 in N. C. Parker, A. E. Giorgi, R. C. Heidinger, D. B. Jester, Jr., E. D. Prince, and G. A. Winans, editors. Fish-marking techniques. American Fisheries Society Symposium 7.
- Carlson, J. and J. J. Hasbrouck. 1993. Marking juvenile coho salmon in the Kenai River with coded, microwire tags. Alaska Department of Fish and Game, Fishery Data Series No. 93-52, Anchorage.
- Carlson, J. and J. J. Hasbrouck. 1996. Estimated harvest of coho salmon of Kenai River origin in commercial fisheries of Upper Cook Inlet Alaska, 1993-1994. Alaska Department of Fish and Game, Fishery Data Series No. 96-7, Anchorage.
- Clark, J. E. and D. R. Bernard. 1987. A compound multivariate binomial-hypergeometric distribution describing coded microwire tag recovery from commercial salmon catches in Southeastern Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet No. 261, Juneau.
- Goodman, L. A. 1960. On the exact variance of products. Journal of the American Statistical Society 55:708-713.
- Hoffmann, A. G. and J. J. Hasbrouck. 1994. Estimates of commercial harvest and escapement of coho salmon stocked into Northern Cook Inlet streams, 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-45, Anchorage.
- Howe, A. L., G. Fidler, A. E. Bingham, and M. J. Mills. 1996. Harvest, catch, and participation in Alaska sport fisheries during 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-32, Anchorage.
- Howe, A. L., G. Fidler, and M. J. Mills. 1995. Harvest, catch, and participation in Alaska sport fisheries during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-24, Anchorage.
- Meyer, S., D. Vincent-Lang, and D. McBride. *Unpublished*. Goal statement and study plan for the development of a stock assessment program for Upper Cook Inlet coho salmon stocks (1991). Alaska Department of Fish and Game, Division of Sport Fish, Anchorage.

LITERATURE CITED (Continued)

- Mills, M. J. 1979. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1978-1979, Project F-9-11, 20 (SW-1), Juneau.
- Mills, M. J. 1980. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21 (SW-1), Juneau.
- Mills, M. J. 1981a. Alaska statewide sport fish harvest studies (1979). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A), Juneau.
- Mills, M. J. 1981b. Alaska statewide sport fish harvest studies (1980). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A), Juneau.
- Mills, M. J. 1982. Alaska statewide sport fish harvest studies (1981). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (SW-I-A), Juneau.
- Mills, M. J. 1983. Alaska statewide sport fish harvest studies (1982). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24 (SW-I-A), Juneau.
- Mills, M. J. 1984. Alaska statewide sport fish harvest studies (1983). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (SW-I-A), Juneau.
- Mills, M. J. 1985. Alaska statewide sport fish harvest studies (1984). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1984-1985, Project F-9-17, 26 (SW-I-A), Juneau.
- Mills, M. J. 1986. Alaska statewide sport fish harvest studies (1985). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1985-1986, Project F-10-1, 27 (RT-2), Juneau.
- Mills, M. J. 1987. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No. 2, Juneau.
- Mills, M. J. 1988. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No. 52, Juneau.
- Mills, M. J. 1989. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No. 122, Juneau.
- Mills, M. J. 1990. Harvest and participation in Alaska sport fisheries during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-44, Anchorage.
- Mills, M. J. 1991. Harvest, catch, and participation in Alaska sport fisheries during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-58, Anchorage.
- Mills, M. J. 1992. Harvest, catch, and participation in Alaska sport fisheries during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-40, Anchorage.
- Mills, M. J. 1993. Harvest, catch, and participation in Alaska sport fisheries during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-42, Anchorage.
- Mills, M. J. 1994. Harvest, catch, and participation in Alaska sport fisheries during 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-28, Anchorage.
- Peltz, L. R. and P. A. Hansen. 1994. Marking, enumeration, and size estimation for coho and chinook salmon smolt releases into Upper Cook Inlet, Alaska in 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-21, Anchorage.
- Peltz, L. R. and D. Starkey. 1993. Summary and synthesis of production, marking, and release data for coho and chinook salmon smolt releases into Upper Cook Inlet, Alaska, in 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-51, Anchorage.
- Sandercock, F. K. 1991. Life history of coho salmon (*Oncorhynchus kisutch*). In C. Groot and L. Margolis, editors. Pacific salmon life histories. UBC Press. Vancouver, B. C., Canada.

LITERATURE CITED (Continued)

- Starkey, D., C. Olito, and P. Hansen 1996. Marking, enumeration, and size estimation for coho and chinook salmon smolt releases into Upper Cook Inlet, Alaska in 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-15, Anchorage.
- Starkey, D., L. Peltz, and P. Hansen 1995. Marking, enumeration, and size estimation for coho and chinook salmon smolt releases into Upper Cook Inlet, Alaska in 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-13, Anchorage.
- Stratton, B., J. J. Hasbrouck, P. Cyr, D. Waltemyer, and K. Rudge. 1995. Northern Cook Inlet urban area coho salmon program: terminal assessment and commercial catch sampling elements. Operational Plan FY96. Alaska Department of Fish and Game, Division of Sport Fish, Anchorage.
- Stratton, B., J. J. Hasbrouck, and P. Cyr. 1996. Estimates of commercial harvest and escapement of coho salmon stocked into Northern Cook Inlet streams, 1994. Alaska Department of Fish and Game, Division of Sport Fish, Fishery Data Series No. 96-4, Anchorage.

**APPENDIX A. SUMMARY OF CODED WIRE TAGGING DATA
BY RELEASE SITE FOR COHO SALMON REARED AT BIG
LAKE, ELMENDORF, AND FORT RICHARDSON
HATCHERIES AND STOCKED IN NORTHERN COOK INLET,
1992-1994**

Appendix A1.-Summary of coded wire tagging data by release site for coho salmon reared at Big Lake, Elmendorf, and Fort Richardson hatcheries and stocked in Northern Cook Inlet, 1992.

	Big Lake Hatchery			Elmendorf Hatchery	Fort Richardson Hatchery			
	Cottonwood Creek	Wasilla Creek	Fish Creek	Ship Creek	Houston	Nancy Lake	Bird Creek	Campbell Creek
Tag Codes	31-20-08 31-20-09	31-20-10 31-20-11	31-20-12 31-20-13	31-19-63 31-20-01	31-20-07	31-20-06	31-20-02 31-20-03	31-20-04 31-20-05
Total marked and tagged ^a	45,500	45,044	46,651	44,807	22,073	21,924	45,173	43,912
Mortalities ^b	10,159	896	1,113	721	189	326	270	231
Marked fish released	35,341	44,148	45,538	44,086	21,884	21,598	44,903	43,681
Tag retention sample size	1,890	1,786	1,798	1,723	842	934	1,684	1,717
Tag retention at release	93.2%	95.1%	95.8%	87.2%	89.4%	89.0%	83.8%	90.3%
Tagged fish released	32,938	41,985	43,625	38,443	19,564	19,222	37,629	39,444
Total fish released ^c	53,900	76,315	74,953	67,178	154,466	158,459	95,377	97,076
Percent tagged	61.1%	55.0%	58.2%	57.2%	12.7%	12.1%	39.5%	40.6%
Theta ^d	0.611	0.550	0.582	0.572	0.127	0.121	0.395	0.406
Tagging dates	3/4-20	4/3-15	3/20-4/3	1/29-2/7	2/27-3/9	2/25-27	3/9-13	3/16-19
Date of tag retention check	6/18	6/18	6/18	5/18-19	5/19-20	5/19-20	5/19-20	5/19-20
Days elapsed ^e	90	64	76	101	71	82	67	61

From: Peltz and Starkey 1993

^a Marked refers to fish with an adipose finclip and tagged refers to fish with an adipose finclip and a coded wire tag.

^b An estimated 7,368 tagged smolt destined for Cottonwood Creek were not released due to their small size.

^c Number released estimated by mark-recapture experiments.

^d Calculated using proportion of tagged fish in total fish released.

^e Number of days between last tagging date and tag retention check date.

Appendix A2.-Summary of coded wire tagging data by release site for coho salmon reared at Big Lake, Elmendorf, and Fort Richardson hatcheries and stocked in Northern Cook Inlet, 1993.

	Big Lake Hatchery			Elmendorf Hatchery	Fort Richardson Hatchery			
	Cottonwood Creek	Fish Creek	Wasilla Creek	Ship Creek	Bird Creek	Campbell Creek	Houston	Nancy Lake
Tag Codes	31-21-41	31-21-40	31-21-42	31-21-36	31-21-39	31-21-38	31-21-37	31-21-37
Total marked and tagged ^a	43,253	44,102	43,139	42,633	43,584	43,554	21,794	21,151
Mortalities	136	52	138	521	143	114	390	150
Marked fish released	43,117	44,050	43,001	42,112	43,441	43,440	21,404	21,001
Tag retention sample size	1,679	2,009	1,647	1,555	1,546	1,544	1,620	1,751
Tag retention at release	94.8%	98.2%	97.0%	98.1%	97.5%	98.8%	96.5%	93.5%
Tagged fish released	40,875	43,257	41,711	41,322	42,350	42,916	20,312	19,930
Total fish released ^b	74,198	67,934	77,174	54,764	140,382	140,797	148,282	131,591
Percent tagged	55.1%	63.7%	54.0%	75.5%	30.2%	30.5%	13.7%	15.1%
Theta ^c	0.551	0.637	0.540	0.755	0.302	0.305	0.137	0.151
Tagging dates	4/21-5/03	5/10-5/17	5/03-5/10	2/16-3/02	3/22-3/31	3/16-3/22	3/08-3/10	3/11-3/16
Date of tag retention check	6/07	6/03	6/07	5/25	5/26	5/27	5/21	5/20
Days elapsed ^d	35	17	28	84	56	66	72	65

From: Peltz and Hansen 1994

^a Marked refers to fish with an adipose finclip and tagged refers to fish with an adipose finclip and a coded wire tag.

^b Number released estimated by mark-recapture experiments except for Ship Creek which was censused by a total count.

^c Calculated using proportion of tagged fish in total fish released.

^d Number of days between last tagging date and tag retention check date.

Appendix A3.-Summary of coded wire tagging data by release site for coho salmon reared at Elmendorf and Fort Richardson hatcheries and stocked in Northern Cook Inlet, 1994.

	Elmendorf	Fort Richardson Hatchery		
	Ship Creek	Bird Creek	Campbell Creek	Little Susitna River
Tag Codes	31-23-04	31-23-02	31-23-03	31-23-01
Total marked and tagged ^a	44,169	45,750	44,276	44,685
Mortalities	138	530	132	196
Marked fish released	44,031	45,220	44,144	44,489
Tag retention sample size	839	762	785	1,590
Tag retention at release	94.8%	98.8%	97.3%	98.5%
Tagged fish released	41,722	44,686	42,963	43,818
Total fish released	75,779	84,643	87,686	126,694
Percent tagged	58.1%	53.4%	50.3%	35.1%
Theta ^b	0.551	0.528	0.490	0.346
Tagging dates	1/10-1/19	11/08-11/15	10/19-10/28	10/28-11/05
Date of tag retention check	5/24	5/25	5/26	5/19-20
Days elapsed ^c	125	191	210	199

From: Starkey et al. 1995

^a Marked refers to fish with an adipose finclip, tagged refers to fish with an adipose finclip and a coded wire tag.

^b Calculated using proportion of tagged fish in total fish released.

^c Number of days between last tagging date and tag retention check date.

**APPENDIX B. COHO SALMON ESCAPEMENT COUNTS AT
SHIP, BIRD, AND CAMPBELL CREEKS AND SELECTED
TURNAGAIN ARM STREAMS**

Appendix B1.-Coho salmon escapement counts in Ship Creek, 1995.

Date	Adipose Fin		Total Coho	Heads Collected	Coho Escapement	
	Present	Absent			Daily	Total
7/17 ^a	1	0	1	0	1	1
7/18	0	0	0	0	0	1
7/19	1	0	1	0	1	2
7/20	0	0	0	0	0	2
7/21	0	0	0	0	0	2
7/22	0	0	0	0	0	2
7/23	0	0	0	0	0	2
7/24	0	0	0	0	0	2
7/25	2	0	2	0	2	4
7/26	2	1	3	0	3	7
7/27	4	0	4	0	4	11
7/28	3	0	3	0	3	14
7/29	3	0	3	0	3	17
7/30	4	2	6	0	6	23
7/31	2	0	2	0	2	25
8/1	2	0	2	0	2	27
8/2	3	0	3	0	3	30
8/3	4	1	5	1	4	34
8/4	0	0	0	0	0	34
8/5	0	0	0	0	0	34
8/6	1	0	1	0	1	35
8/7	3	1	4	0	4	39
8/8	1	1	2	0	2	41
8/9	5	6	11	3	8	49
8/10	7	9	16	5	11	60
8/11	6	6	12	3	9	69
8/12	6	2	8	1	7	76
8/13	4	4	8	2	6	82
8/14	6	4	10	2	8	90
8/15	8	2	10	1	9	99
8/16	2	8	10	5	5	104
8/17	12	6	18	3	15	119
8/18	6	6	12	3	9	128
8/19	5	4	9	2	7	135
8/20	6	2	8	1	7	142
8/21	5	5	10	2	8	150
8/22	23	27	50	13	37	187
8/23	39	32	71	16	55	242
8/24	13	8	21	3	18	260
8/25	11	18	29	9	20	280
8/26	18	10	28	5	23	303
8/27	58	56	114	29	85	388
8/28 ^b	74	71	145	4	141	529
8/29	38	48	86	11	75	604
8/30	9	15	24	3	21	625
8/31	21	25	46	5	41	666

-continued-

Appendix B1.-Page 2 of 2.

Date	Adipose Fin		Total Coho	Heads Collected	Coho Escapement	
	Present	Absent			Daily	Total
9/1	11	13	24	3	21	687
9/2	0	0	0	0	0	687
9/3	0	0	0	0	0	687
9/4	0	0	0	0	0	687
9/5	0	0	0	0	0	687
9/6	12	19	31	5	26	713
9/7	15	19	34	4	30	743
9/8	7	8	15	1	14	757
9/9	0	0	0	0	0	757
9/10	0	0	0	0	0	757
9/11	0	0	0	0	0	757
9/12	11	16	27	0	27	784
9/13	2	5	7	0	7	791
9/14	6	8	14	0	14	805
9/15	2	3	5	0	5	810
9/16	3	2	5	0	5	815
9/17	2	2	4	0	4	819
9/18	12	6	18	0	18	837
9/19	7	5	12	0	12	849
9/20	3	6	9	0	9	858
Total	511	492	1003	145	858	

^a Weir in operation since 5/14, no coho observed until 7/17.

^b Weir checked twice, once by fishery technicians, once by hatchery personnel. Heads were collected by fishery technicians. Fish passed by hatchery personnel were not examined for the presence or absence of adipose fins, adipose fin presence or absence based on season totals.

Appendix B2.-Coho salmon escapement counts from foot surveys in Bird and Campbell creeks, 1995.

Stream	Date	Live	Dead	Total
Bird Creek Drainage				
Penguin Creek	9-Oct	97	18	115
Bird Creek Falls downstream to marker cable	9-Oct	24	0	24
Total		121	18	139
Campbell Creek Drainage				
Upper S. Fork	11-Oct	106	12	118
Lower S. Fork	11-Oct	389	107	496
Upper N. Fork	11-Oct	82	48	130
Lower N. Fork	11-Oct	163	274	437
Upstream of Piper St. Total		740	441	1,181
Piper St. to Lake Otis	12-Oct	73	26	99
Lake Otis to C Street	12-Oct	68	75	143
Downstream of Piper St. Total		141	101	242
Grand Total		881	542	1,423

Appendix B3.-Salmon escapement counts from aerial surveys in selected Turnagain Arm streams, 1994 and 1995.

Stream	1994		1995	
	Coho	Chum	Coho	Chum
Twentymile River Drainage				
Ahjo Creek	75	0	65	0
NE Fork	75	0	210	0
Mainstem	780	0	592	0
Beaver Pond	^a	^a	120	0
Glacier River	50	20	0	26
Upper Carmen River	0	0	0	0
South Fork Carmen River	6	0	0	0
Total	986	20	987	26
Portage Creek Drainage				
Mainstem ^b	40	20	10	0
Upper Railroad Slough	0	0	210	0
Lower Railroad Slough	0	0	40	0
Williwaw ^b	30	907	35	611
Placer Creek	0	0	57	0
Total	70	927	352	611
Placer River Drainage				
Sloughs and Mainstem	55	0	90	9
Skookum Creek	750	0	720	0
Explorer Creek ^b	804	2	350	0
Total	1,609	0	1,160	9

^a No count.

^b Foot survey counts conducted by United States Forest Service personnel.

**APPENDIX C. ESTIMATES BY RELEASE SITE OF COHO
SALMON STOCKED IN 1992, 1993, AND 1994 THAT WERE
HARVESTED IN UPPER COOK INLET COMMERCIAL
FISHERIES IN 1995**

Appendix C1.-Estimates (n) and standard error (SE) of coho salmon stocked in 1992 by release site in Upper Cook Inlet Central District drift net (244-00, 245-00) commercial harvest, 1995.

Date	Coho Catch	Fish Creek		Cottonwood Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	percent
6/26-7/07	24,901	0		0		0		0.0%
7/10	26,112	0		0		0		0.0%
7/14	1,523	0		0		0		0.0%
7/17	56,387	0		0		0		0.0%
7/21	36,032	0		0		0		0.0%
7/24	17,287	0		0		0		0.0%
7/25	839	0		0		0		0.0%
7/27	4,799	0		0		0		0.0%
7/28	23,446	0		0		0		0.0%
7/31	14,085	0		6	6	6	6	0.0%
8/04	15,462	0		0		0		0.0%
8/07	4,558	0		4	4	4	4	0.1%
8/11	3,493	0		0		0		0.0%
8/14	2,256	0		0		0		0.0%
8/18-9/01	2,946	0		0		0		0.0%
Total^a	234,126	0		11	7	10	7	0.0%

^a Totals may not equal sum of individual estimates due to rounding.

Appendix C2.-Estimates (n) and standard error (SE) of coho salmon stocked in 1992 by release site in Upper Cook Inlet Northern District Susitna Flats/Point MacKenzie (247-41, 247-42) setnet commercial harvest, 1995.

Date	Coho Catch	Fish Creek		Cottonwood Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	percent
7/10-7/17	712	0		0		0		0.0%
7/21	726	0		0		0		0.0%
7/28	353	0		0		0		0.0%
7/31	809	3	2	0		3	2	0.4%
8/04	445	0		0		0		0.0%
8/07	368	0		0		0		0.0%
8/11	155	0		0		0		0.0%
8/14	166	0		0		0		0.0%
8/18-9/01	512	0		0		0		0.0%
Total	4,246	3		0		3	2	0.1%

Appendix C3.-Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District drift net (244-00, 245-00) commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Bird Creek		Ship Creek		Fish Creek		Wasilla Creek		Cottonwood Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	percent
6/26-7/07	24,901	0		0		0		0		10	9	0		10	9	0.0%
7/10	26,112	0		0		0		0		13	9	20	10	33	14	0.1%
7/14	1,523	0		0		0		0		0		5	5	5	5	0.3%
7/17	56,387	0		17	16	0		8	7	19	13	28	15	72	27	0.1%
7/21	36,032	0		0		0		0		56	20	39	16	96	26	0.3%
7/24	17,287	0		0		0		0		5	5	46	14	51	14	0.3%
7/25	839	0		0		0		0		0		0		0		0.0%
7/27	4,799	0		0		0		0		14	14	0		14	14	0.3%
7/28	23,446	0		0		10	6	12	7	176	32	106	24	304	41	1.3%
7/31	14,085	0		0		0		24	11	65	20	64	20	153	30	1.1%
8/04	15,462	0		0		0		17	11	89	28	125	33	231	45	1.5%
8/07	4,558	0		0		0		4	4	5	5	45	13	54	15	1.2%
8/11	3,493	0		0		0		0		12	11	35	19	47	22	1.3%
8/14	2,256	0		0		0		4	4	10	7	15	8	30	11	1.3%
8/18-9/01	2,946	0		0		0		0		0		0		0		0.0%
Total	234,126	0		17	16	10	6	69	20	475	58	528	59	1,099	87	0.5%

Appendix C4.-Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District Ninilchik Beach (244-21) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Bird Creek		Ship Creek		Fish Creek		Wasilla Creek		Cottonwood Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/03-7/17	236	0		0		0		0		0		0		0		0.0%
7/18	110	0		0		0		0		0		0		0		0.0%
7/21	207	0		0		0		0		0		0		0		0.0%
7/24	763	0		0		0		0		0		0		0		0.0%
7/25	261	0		0		0		0		0		3	3	3	3	1.1%
7/27	605	0		0		0		0		0		0		0		0.0%
7/28-7/29	734	0		0		0		0		0		0		0		0.0%
7/30-7/31	506	0		0		0		0		0		0		0		0.0%
8/01	335	0		0		0		0		0		0		0		0.0%
8/04	887	0		0		0		0		0		0		0		0.0%
8/07	307	0		0		0		0		0		0		0		0.0%
8/11	461	0		0		0		0		0		0		0		0.0%
8/14	964	0		0		0		0		0		0		0		0.0%
Total	6,376	0		0		0		0		0		3		3	3	0.0%

Appendix C5.-Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District Cohoe Beach (244-22) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Bird Creek		Ship Creek		Fish Creek		Wasilla Creek		Cottonwood Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/03-7/14	356	0		0		0		0		0		0		0		0.0%
7/17	334	0		0		0		0		0		0		0		0.0%
7/18	229	0		0		0		0		0		0		0		0.0%
7/21	473	0		0		0		0		0		0		0		0.0%
7/24	842	0		0		0		0		0		0		0		0.0%
7/25	272	0		0		0		0		0		0		0		0.0%
7/27	475	0		0		0		0		0		0		0		0.0%
7/28	482	0		0		0		4	3	0		0		4	3	0.8%
7/29	482	0		0		0		0		0		11	10	11	10	2.3%
7/31	1,108	0		0		0		0		0		5	5	5	5	0.5%
8/01	227	0		0		0		0		5	4	0		5	4	2.2%
8/04	561	0		0		0		0		0		0		0		0.0%
8/05	727	0		0		0		0		0		0		0		0.0%
8/07	339	0		0		0		0		0		0		0		0.0%
8/11	628	0		0		0		0		0		0		0		0.0%
8/14	1,083	0		0		0		0		0		0		0		0.0%
Total	8,618	0		0		0		4	3	5	4	16	11	25	13	0.3%

Appendix C6.-Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District Kalifornski Beach (244-30) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Bird Creek		Ship Creek		Fish Creek		Wasilla Creek		Cottonwood Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/03-714	992	0		0		0		0		0		0		0		0.0%
7/17	1,666	0		0		0		0		0		0		0		0.0%
7/18	284	0		0		0		0		0		0		0		0.0%
7/21	708	0		0		0		0		0		0		0		0.0%
7/24	625	0		0		0		0		0		0		0		0.0%
7/25	497	0		0		0		0		0		0		0		0.0%
7/27	312	0		0		0		0		0		0		0		0.0%
7/28	1,048	0		0		0		0		0		0		0		0.0%
7/31	1,310	0		0		0		0		0		0		0		0.0%
8/01	252	0		0		0		0		0		0		0		0.0%
8/04	1,843	0		0		0		0		0		0		0		0.0%
8/07	614	0		0		0		0		0		0		0		0.0%
8/11	1,007	0		0		0		0		8	7	8	7	16	10	1.6%
8/14	984	0		0		0		0		0		0		0		0.0%
Total	12,142	0		0		0		0		8	7	8	7	16	10	0.1%

Appendix C7.-Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Central District Salamatof Beach (244-40) setnet commercial harvest, 1995.

	Coho	Little Susitna River		Bird Creek		Ship Creek		Fish Creek		Wasilla Creek		Cottonwood Creek		NCI Hatchery Contribution		
Date	Catch	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/03-7/14	2,047	0		0		0		0		0		0		0		0.0%
7/17	1,083	0		0		0		0		0		16	15	16	15	1.5%
7/21	1,332	0		0		0		6	6	0		0		6	6	0.5%
7/24	2,423	0		0		0		0		19	18	0		19	18	0.8%
7/25	743	0		0		0		0		0		7	6	7	6	0.9%
7/27	602	0		0		0		0		0		0		0		0.0%
7/28	1,889	0		0		0		0		47	46	0		47	46	2.5%
7/31	1,796	0		0		0		0		0		15	14	15	14	0.8%
8/01	548	0		0		0		0		7	6	0		7	6	1.3%
8/04	1,859	0		0		0		0		0		0		0		0.0%
8/07	834	0		0		0		0		0		0		0		0.0%
8/11	1,169	0		0		0		0		0		0		0		0.0%
8/14	1,289	0		0		0		0		0		0		0		0.0%
Total ^a	17,614	0		0		0		6	6	72	50	37	22	117	55	0.7%

^a Totals may not equal sum of individual estimates due to rounding.

Appendix C8.-Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Northern District westside (247-10, 247-20, 247-30) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Bird Creek		Ship Creek		Fish Creek		Wasilla Creek		Cottonwood Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	percent
6/30-7/14	7,723	0		0		0		0		0		0		0		0.0%
7/17	10,892	0		0		0		0		0		0		0		0.0%
7/21	17,759	0		0		0		0		0		0		0		0.0%
7/28	10,244	121	71	0		0		7	6	0		0		128	71	1.2%
7/31	4,156	0		0		0		3	2	0		0		3	2	0.1%
8/04	3,902	0		0		9	3	3	2	19	7	3	3	34	8	0.9%
8/07	3,489	0		0		0		0		17	6	36	8	53	10	1.5%
8/11	1,934	0		0		0		0		4	3	14	6	18	7	0.9%
8/14	1,545	0		0		0		0		6	2	8	3	14	3	0.9%
8/18	1,819	0		0		0		3	2	3	3	0		6	3	0.3%
8/21-9/04	1,592	0		0		0		0		16	8	26	10	42	13	2.6%
Total^a	65,055	121	71	0		9	3	15	8	65	13	87	15	298	74	0.5%

^a Totals may not equal sum of individual estimates due to rounding.

Appendix C9.-Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Northern District Susitna Flats/Point MacKenzie (247-41, 247-42) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Bird Creek		Ship Creek		Fish Creek		Wasilla Creek		Cottonwood Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/10-7/17	712	0		0		0		0		0		0		0		0.0%
7/21	726	0		0		0		0		9	4	11	5	20	6	2.8%
7/28	353	0		0		0		0		2	1	8	3	10	3	2.8%
7/31	809	0		0		0		2	2	11	4	5	3	18	6	2.2%
8/04	445	0		0		0		0		7	3	7	3	14	4	3.1%
8/07	368	0		0		0		0		14	7	38	12	52	14	14.1%
8/11	155	0		0		0		0		7	3	5	2	12	4	7.7%
8/14	166	0		0		0		2	2	8	4	8	3	18	5	10.8%
8/18-9/01	512	0		0		0		0		34	33	0		34	33	6.6%
Total^a	4,246	0		0		0		5	2	92	35	81	14	178	38	4.2%

^a Totals may not equal sum of individual estimates due to rounding.

Appendix C10.-Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Northern District Fire Island (247-43) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Bird Creek		Ship Creek		Fish Creek		Wasilla Creek		Cottonwood Creek		NCI Hatchery Contribution		percent
		n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	
7/03-7/17	620	0		0		0		0		0		0		0		0.0%
7/21	646	0		0		0		0		2	2	4	2	6	3	0.9%
7/28	474	0		0		0		3	1	2	1	8	3	13	3	2.7%
7/31	789	0		0		0		3	2	9	4	0		12	5	1.5%
8/04	417	0		0		0		6	5	28	13	0		34	14	8.2%
8/07	476	0		0		0		0		6	3	9	4	15	5	3.2%
8/11	369	0		0		0		2	1	2	2	2	2	6	3	1.6%
8/14	293	0		0		2	2	3	2	23	7	13	5	41	9	14.0%
8/18	312	0		0		0		3	2	7	4	3	3	13	5	4.2%
8/21-9/04	1,616	0		0		0		0		21	21	62	35	83	40	5.1%
Total	6,012	0		0		2	2	20	7	100	26	101	36	223	45	3.7%

Appendix C11.-Estimates (n) and standard error (SE) of coho salmon stocked in 1993 by release site in Upper Cook Inlet Northern District eastside (247-70, 247-80, 247-90) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Bird Creek		Ship Creek		Fish Creek		Wasilla Creek		Cottonwood Creek		NCI Hatchery Contribution		percent
		n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	n	SE	
6/30-7/21	2,531	0		0		0		0		0		0		0		0.0%
7/31	959	0		0		0		0		0		0		0		0.0%
8/04	472	0		0		0		0		0		0		0		0.0%
8/07	894	0		0		0		0		6	2	0		6	2	0.7%
8/11	788	0		0		0		0		0		0		0		0.0%
8/14	883	0		0		0		0		12	3	0		12	3	1.4%
8/18	1,860	0		0		0		0		6	2	0		6	2	0.3%
8/21	1,368	0		0		0		2	1	0		2	1	4	1	0.3%
8/25	1,126	0		0		0		0		0		0		0		0.0%
8/28	177	0		0		0		0		0		0		0		0.0%
9/01	533	0		0		0		0		0		0		0		0.0%
9/04-9/11	397	0		0		0		0		0		0		0		0.0%
Total	11,988	0		0		0		2	1	24	5	2	1	28	5	0.2%

Appendix C12.-Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District drift net (244-00, 245-00) commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	percent
6/26-7/07	24,901	182	51	0		139	37	89	28	410	69	1.6%
7/10	26,112	250	48	0		184	34	171	31	605	67	2.3%
7/14	1,523	25	14	0		30	12	28	11	83	21	5.4%
7/17	56,387	826	106	19	12	396	61	628	73	1,868	143	3.3%
7/21	36,032	689	89	24	13	602	68	681	70	1,996	133	5.5%
7/24	17,287	306	46	10	6	353	41	317	37	986	72	5.7%
7/25	839	0		0		9	9	9	8	18	12	2.2%
7/27	4,799	111	49	0		94	37	132	42	337	74	7.0%
7/28	23,446	720	83	86	22	479	55	534	56	1,820	116	7.8%
7/31	14,085	618	79	212	36	405	52	390	49	1,625	112	11.5%
8/04	15,462	230	57	444	61	347	58	262	49	1,283	113	8.3%
8/07	4,558	63	21	84	18	28	11	31	11	207	32	4.5%
8/11	3,493	18	18	116	35	13	12	0		147	41	4.2%
8/14	2,256	0		179	27	0		5	5	184	27	8.2%
8/18-9/01	2,946	0		0		0		0		0		0.0%
Total	234,126	4,039	214	1,173	90	3,077	154	3,277	153	11,566	318	4.9%

Appendix C13.-Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District Ninilchik Beach (244-21) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/03-7/17	236	0		0		0		0		0		0.0%
7/18	110	0		0		0		0		0		0.0%
7/21	207	0		0		0		0		0		0.0%
7/24	763	0		0		0		0		0		0.0%
7/25	261	0		0		4	3	3	3	7	4	2.7%
7/27	605	0		0		0		9	8	9	8	1.5%
7/28-7/29	734	0		0		0		0		0	0	0.0%
7/30-7/31	506	0		0		0		0		0		0.0%
8/01	335	0		0		0		0		0		0.0%
8/04	887	0		0		0		0		0		0.0%
8/07	307	0		0		0		0		0		0.0%
8/11	461	0		4	3	0		0		4	3	0.8%
8/14	964	0		0		10	10	0		10	10	1.1%
Total	6,376	0		4	3	14	10	12	9	30	14	0.5%

Appendix C14.-Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District Coho Beach (244-22) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/03-7/14	356	0		0		0		24	16	24	16	6.8%
7/17	334	0		0		0		0		0		0.0%
7/18	229	0		0		0		10	9	10	9	4.3%
7/21	473	0		0		0		12	12	12	12	2.6%
7/24	842	0		0		0		8	7	8	7	0.9%
7/25	272	0		0		0		0		0		0.0%
7/27	475	8	8	0		0		11	7	19	11	4.0%
7/28	482	0		0		0		0		0		0.0%
7/29	482	0		0		0		0		0		0.0%
7/31	1,108	8	8	5	5	6	5	0		19	10	1.7%
8/01	227	0		0		0		5	4	5	4	2.2%
8/04	561	0		0		0		0		0		0.0%
8/05	727	0		0		0		0		0		0.0%
8/07	339	0		0		3	2	0		3	2	0.8%
8/11	628	0		0		0		0		0		0.0%
8/14	1,083	0		0		0		0		0		0.0%
Total^a	8,618	17	11	5	5	9	6	70	25	100	28	1.2%

^a Totals may not equal sum of individual estimates due to rounding.

Appendix C15.-Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District Kalifornski Beach (244-30) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/03-7/14	992	0		0		8	8	8	7	16	11	1.6%
7/17	1,666	118	118	0		0		0		118	118	7.1%
7/18	284	0		0		0		0		0		0.0%
7/21	708	0		0		16	15	0		16	15	2.2%
7/24	625	18	18	0		0		0		18	18	2.9%
7/25	497	0		0		0		47	47	47		9.5%
7/27	312	0		0		0		0		0		0.0%
7/28	1,048	0		0		0		23	23	23	23	2.2%
7/31	1,310	0		0		0		0		0		0.0%
8/01	252	0		0		0		0		0		0.0%
8/04	1,843	0		0		0		0		0		0.0%
8/07	614	0		0		0		0		0		0.0%
8/11	1,007	0		8	7	0		0		8	7	0.7%
8/14	984	0		13	12	0		0		13	12	1.3%
Total	12,142	136	119	20	14	24	17	78	52	258	132	2.1%

Appendix C16.-Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Central District Salamatof Beach (244-40) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/03-7/14	2,047	0		0		11	0	0		11		0.5%
7/17	1,083	0		0		0		16	16	16	16	1.5%
7/21	1,332	12	11	0		25	13	23	12	60	21	4.5%
7/24	2,423	29	29	18	18	0		19	19	66	39	2.7%
7/25	743	44	21	0		8	7	7	7	59	23	7.9%
7/27	602	0		0		0		6	6	6	6	1.0%
7/28	1,889	0		46	45	0		0		46	45	2.4%
7/31	1,796	70	39	0		49	27	0		119	48	6.6%
8/01	548	32	18	0		15	10	14	9	61	22	11.1%
8/04	1,859	0		0		24	16	11	11	35	19	1.9%
8/07	834	0		6	5	0		0		6	5	0.7%
8/11	1,169	0		0		0		0		0		0.0%
8/14	1,289	0		13	12	14	14	0		27	18	2.1%
Total^a	17,614	187	57	83	50	146	39	98	32	512	91	2.9%

^a Totals may not equal sum of individual estimates due to rounding.

Appendix C17.-Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Northern District westside (247-10, 247-20, 247-30) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	percent
6/30-7/14	7,723	0		0		0		0		0		0.0%
7/17	10,892	52	22	0		15	10	7	6	74	25	0.7%
7/21	17,759	110	26	0		41	13	48	13	199	32	1.1%
7/28	10,244	142	41	0		64	23	34	16	239	49	2.3%
7/31	4,156	89	20	3	3	8	5	4	3	104	21	2.5%
8/04	3,902	86	19	6	4	32	9	36	9	160	23	4.1%
8/07	3,489	58	14	42	9	38	9	12	5	148	19	4.3%
8/11	1,934	17	9	32	9	8	5	4	3	60	14	3.1%
8/14	1,545	8	4	36	6	4	2	4	2	52	7	3.4%
8/18	1,819	5	5	45	10	0		0		50	11	2.7%
8/21-9/04	1,592	0		151	24	0		5	5	156	25	9.8%
Total	65,055	565	63	315	30	209	31	153	25	1,242	80	1.9%

Appendix C18.-Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Northern District Susitna Flats/Point MacKenzie (247-41, 247-42) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/10-7/17	712	79	24	0		12	8	0		91	26	12.8%
7/21	726	68	15	0		22	7	18	6	108	18	14.8%
7/28	353	17	6	0		7	3	7	3	31	7	8.8%
7/31	809	100	18	0		28	7	26	7	153	21	18.9%
8/04	445	43	11	5	2	23	6	9	4	80	13	18.0%
8/07	368	22	12	24	9	21	9	0		67	18	18.2%
8/11	155	18	7	5	2	3	2	2	2	28	8	17.8%
8/14	166	21	8	5	3	0		0		26	8	15.5%
8/18-9/01	512	0		100	55	0		0		100	55	19.4%
Total^a	4,246	369	39	137	55	116	17	62	10	682	71	16.1%

^a Totals may not equal sum of individual estimates due to rounding.

Appendix C19.-Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Northern District Fire Island (247-43) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	percent
7/03-7/17	620	43	16	0		51	14	33	11	127	129	20.5%
7/21	646	42	10	0		57	9	37	7	136	16	21.1%
7/28	474	9	4	4	2	66	9	36	6	115	12	24.3%
7/31	789	68	16	3	2	75	13	73	12	219	24	27.8%
8/04	417	108	31	0		129	27	134	26	371	18	89.0%
8/07	476	9	6	14	5	23	7	21	6	67	12	14.1%
8/11	369	7	5	26	6	34	7	29	6	96	12	26.0%
8/14	293	5	5	42	9	11	5	7	4	65	12	22.2%
8/18	312	5	5	63	12	0		0		68	13	21.8%
8/21-9/04	1,616	33	32	413	84	46	32	0		492	96	30.4%
Total^a	6,012	331	53	565	86	493	50	371	34	1,756	117	29.2%

^a Totals may not equal sum of individual estimates due to rounding.

Appendix C20.-Estimates (n) and standard error (SE) of coho salmon stocked in 1994 by release site in Upper Cook Inlet Northern District eastside (247-70, 247-80, 247-90) setnet commercial harvest, 1995.

Date	Coho Catch	Little Susitna River		Ship Creek		Campbell Creek		Bird Creek		NCI Hatchery Contribution		
		n	SE	n	SE	n	SE	n	SE	n	SE	percent
6/30-7/21	2,531	30	21	0		128	35	168	38	325	55	12.9%
7/31	959	28	27	0		79	38	37	25	144	53	15.0%
8/04	472	0		2	1	4	2	10	3	16	4	3.4%
8/07	894	6	3	2	1	11	4	14	4	33	6	3.7%
8/11	788	3	2	6	2	0		6	2	14	4	1.8%
8/14	883	0		32	5	6	3	6	2	45	6	5.1%
8/18	1,860	0		82	8	4	2	2	1	88	9	4.7%
8/21	1,368	0		102	9	0		4	2	106	10	7.7%
8/25	1,126	0		51	7	0		0		51	7	4.5%
8/28	177	0		13	3	0		0		13	3	7.2%
9/01	533	0		27	5	0		0		27	5	5.1%
9/04-9/11	397	0		16	5	0		0		16	5	4.0%
Total	11,988	67	35	333	17	232	52	246	46	878	79	7.3%